The Story of the

TEXAN

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Foreword

by Leo J. Kohn

All photos from Collect-Air Photos

Spin the globe. Touch it to a quick stop. Where your finger rests, if it rests on any land portion, will more than likely be a country where the North American AT-6 type advanced-training airplane has served at one time or another. In fact, there are perhaps only a handful of very small national entities that have not heard the howl of the AT-6 in their skies. Like the DC-3, and probably even more so, the training airplane that North American built has spread amoeba-like all over the world. Almost every nation in the world flew them or had some of their pilots trained in them, even former and present adversaries.

One of the most durable airplanes ever built, smaller air forces around the world still use it as a tactical airplane almost 40 years after it first was formed in pencil on a drawing board.

The name **Texan** was applied to Army AT-6's and up, and Navy and Marine SNJ-3's on up, and is used more as a generic name covering all models. In practice, however, the name **Texan** was long in taking hold with the plain **Six** or SNJ being much preferred. Every model from SNJ-1 through SNJ-6 was also used by the Marine Corps. But, the story of the **Texan**--call it what you will--is not all that easy to tell. It is, in fact, quite involved, and at times quite confusing, so we have to go back a few years.

A design competition was authorized by the U. S. Army Air Corps in 1937 to develop a Basic Combat trainer, an entirely new category of airplane in the Air Corps' scheme of things, which was to incorporate the equipment and characteristics of an operational combat airplane. In effect, it was to be a combat-effective airplane to be used as a trainer if not for combat.

North American Aviation, Inc., up to that time, had two spectacular successes in designing and developing airplanes, and landing substantial military contracts in a relatively short time. Out of the morass of companies that comprised the aviation activities of General Motors Corp. since 1929, North American Aviation, Inc. emerged in 1935 in its Inglewood, California location. The new company had won a contract for the O-47, which they designed and sold to the Army Air Corps, and the BT-9 which was the winner of a competition for a new Basic Trainer airplane. North American Aviation was from that point on solidly cast into a role of builders of military aircraft and is still a principal arsenal for military hardware, despite a few lesser forays into the civil-aviation market.

Backtracking a bit, the BT-9 was designed by James Kindelberger in 1935 with the prototype completed, all in only nine weeks in order to meet the three-month deadline to enter their design into the Basic Trainer competition. Assisting Kindelberger was James Leland Atwood as Chief Engineer of the Manufacturing Division, and R. H. Rice who was Chief of Stress and Design. This design, the model NA-16, embodied the long-brewing ideas of Kindelberger for a rugged, easily maintained airplane, much different from the standard big biplane types theretofore used. The NA-16 would be a low-wing full-cantilever airplane featuring an all-metal wing, steel-tube fuselage with removable fabric-covered side panels for easy access, and single-leg landing gear. The NA-16 handily won the competition along with a contract for 42 airplanes, with follow-on contracts for additional machines. The airplane received the Air Corps designation of BT-9, and the new com-

pany designation as NA-19. The BT-9 was little different from the NA-16 other than the enclosed greenhouse-type cockpit canopy, and faired half-spatted landing gear. The BT-9 quickly became the standard trainer in the Air Corps, and the Navy also purchased it as the NJ-1 and the Canadians bought it as the **Yale.** France placed an order for 200 modified versions, Sweden bought some as did the Brazilian Navy, and the prototype was refurbished and sold to Argentina.

In its own confusing way the NA-16 was the progenitor of a wide array of airplanes. The Navy tested an NJ-1 as the NJ-2 fitted with a Ranger XV-770-4 inverted-vee engine but changed it back to NJ-1 status.

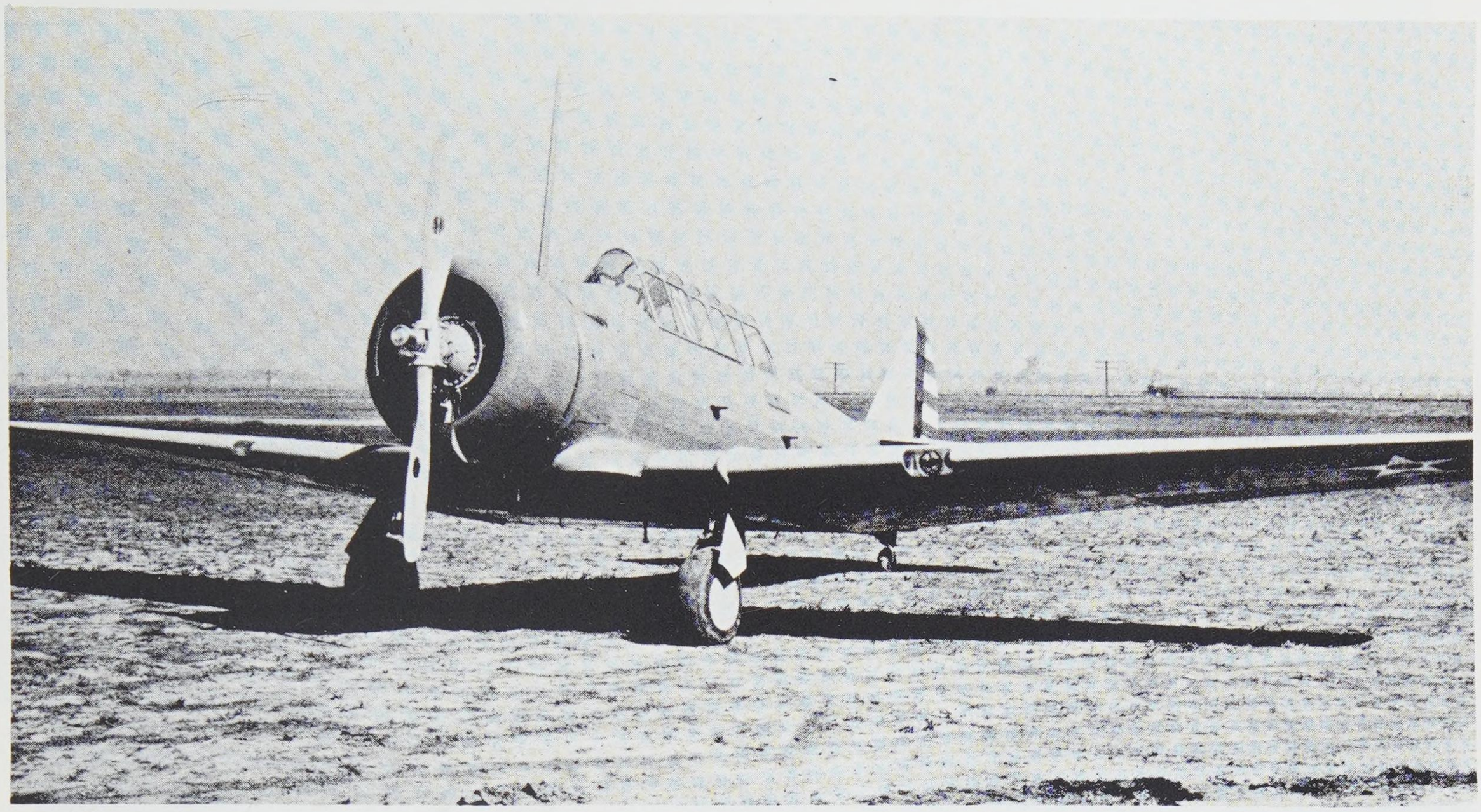
With this solid achievement to its credit, North American Aviation's engineers took the basic NA-16 design and added a 600-hp Pratt & Whitney R-1340-47 engine, a flush-retracting landing gear, provision for armament, two-way radio, and a full complement

The North American BT-9 was the second military aircraft produced in quantity by North American Aviation. AAC 36-124, seen here in blue and yellow, typified the military trainer of the period. Derived from the model NA-16, the Texan had its roots in this airplane.

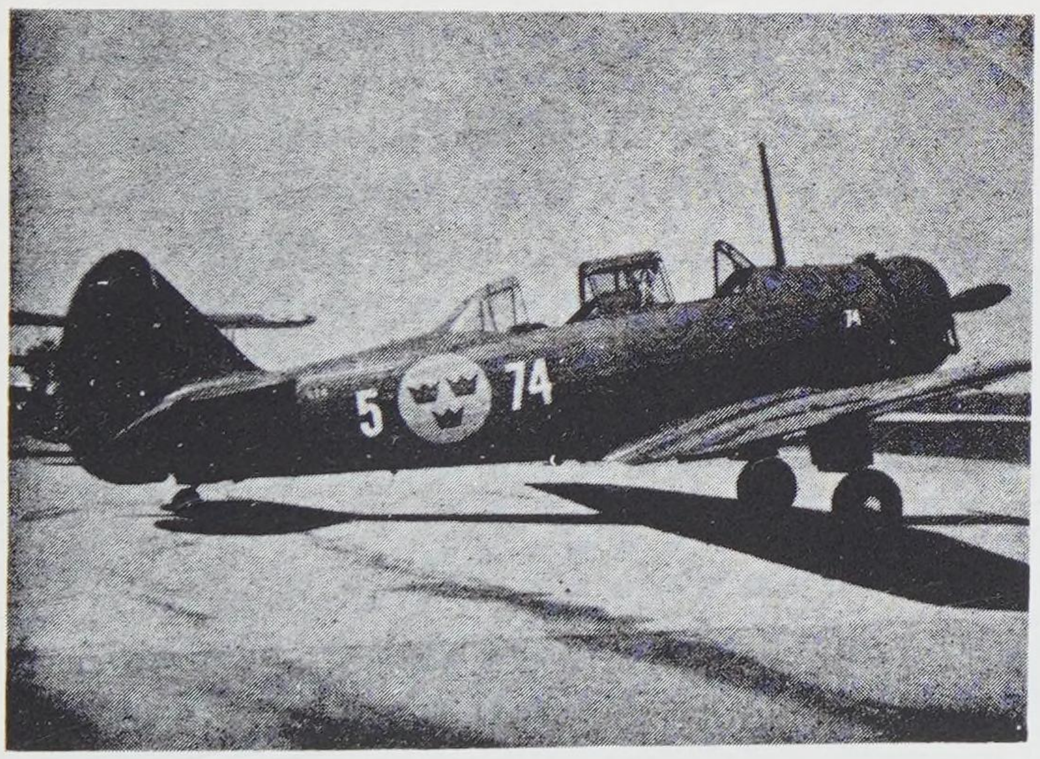
of engine, flight and navigational instruments. This was the model NA-26 of 1937, the prototype which won the Air Corps competition to become the new BC-1, the Basic Combat trainer. This new contract called for 180 aircraft, produced as the NA-36 for the company's accounting purposes. Thirty airplanes were equipped for instrument training and designated as the BC-1I.

The U. S. Navy also displayed interest in the BC-1, and ordered 16 in 1939 as the SNJ-1. These were ordered with a metal fuselage but were otherwise identical with the later **Harvard,** and were built as the company's model NA-52.

Meanwhile, the Royal Australian Air Force had become interested in acquiring a military aircraft that could be manufactured indigenously, and the Commonwealth Aircraft Corporation, Ltd. arranged for a license to build a version of the NA-16 in Australia. Under this agreement, North American built two prototypes: the first, the model NA-16-1A, was shipped as the NA-32; the second prototype,

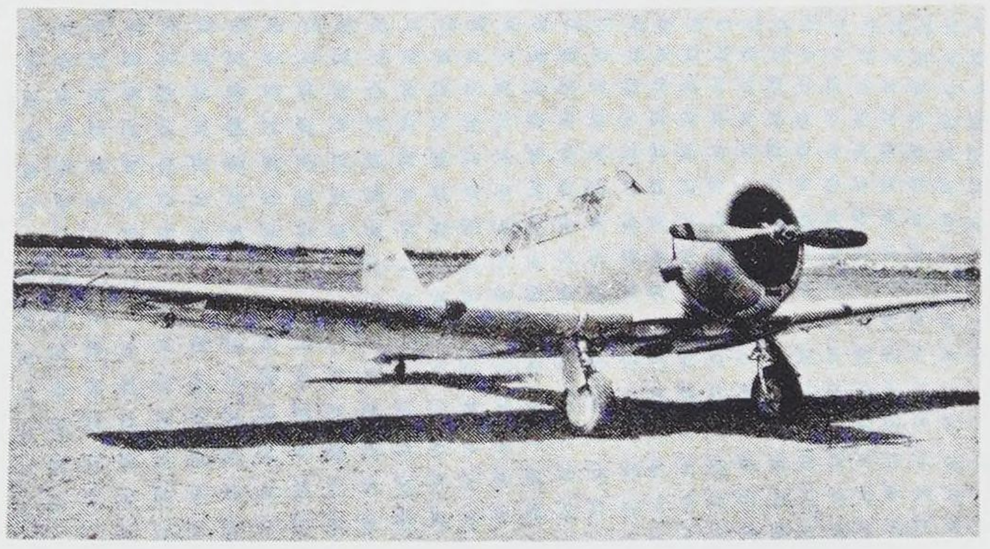


North American BC-1 of 1937 had rounded tapered wing tips, steel-tube fuselage with fabric covering, and a squared off rudder. Its performance was on a par with most of the first-line Air Corps equipment at that time.



This NA–16, number 674 of the Royal Swedish Air Force, was identical to the BT–9 but was fitted with low–pressure tires and wheels.

the NA-16-3, was shipped for evaluation as the NA-33 in September, 1937. These two airplanes became the prototypes for the Australian **Wirraway,** the first of which was delivered to the Royal Australian Air Force in July, 1939. The **Wirraway** was powered by a Commonwealth-built Pratt & Whitney R-1340-S1H1-G of 600 hp. Subsequently, 717 **Wirraway** trainers were delivered up to August 31, 1945, many of which were used



The SNJ-1 was rare and is little remembered, but it was basically like the BC-1 but had a metal fuselage and the blunter wing tips that identified all of the subsequent models of the Texan. This SNJ-1 bears the BuA serial 1552.

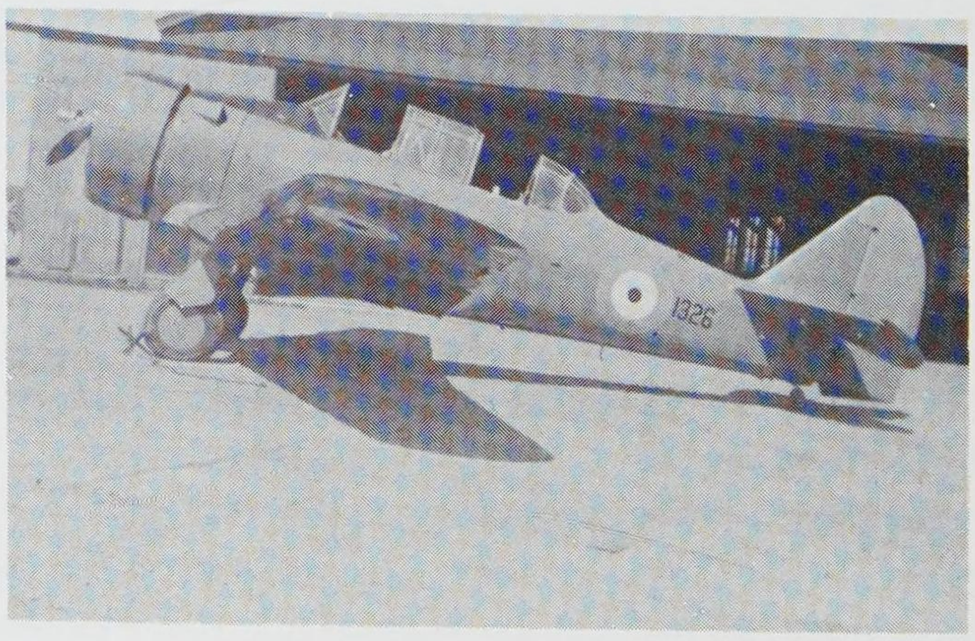
in combat roles. It looked similar to the BC-1 but had a rounded bottom to the rudder as on the BT-9, and swung a three-blade propeller.

With the spectre of war and irreversible national involvement looming steadily over Britain, the need for expanded pilot training became urgent. In 1938 the British government placed orders for a version of the NA-16-3, to be known as the **Harvard.** This model had the rounded wing tips, stubby nose and squared-off rudder as did the BC-1, and had a Hamilton Standard constant-speed pro-

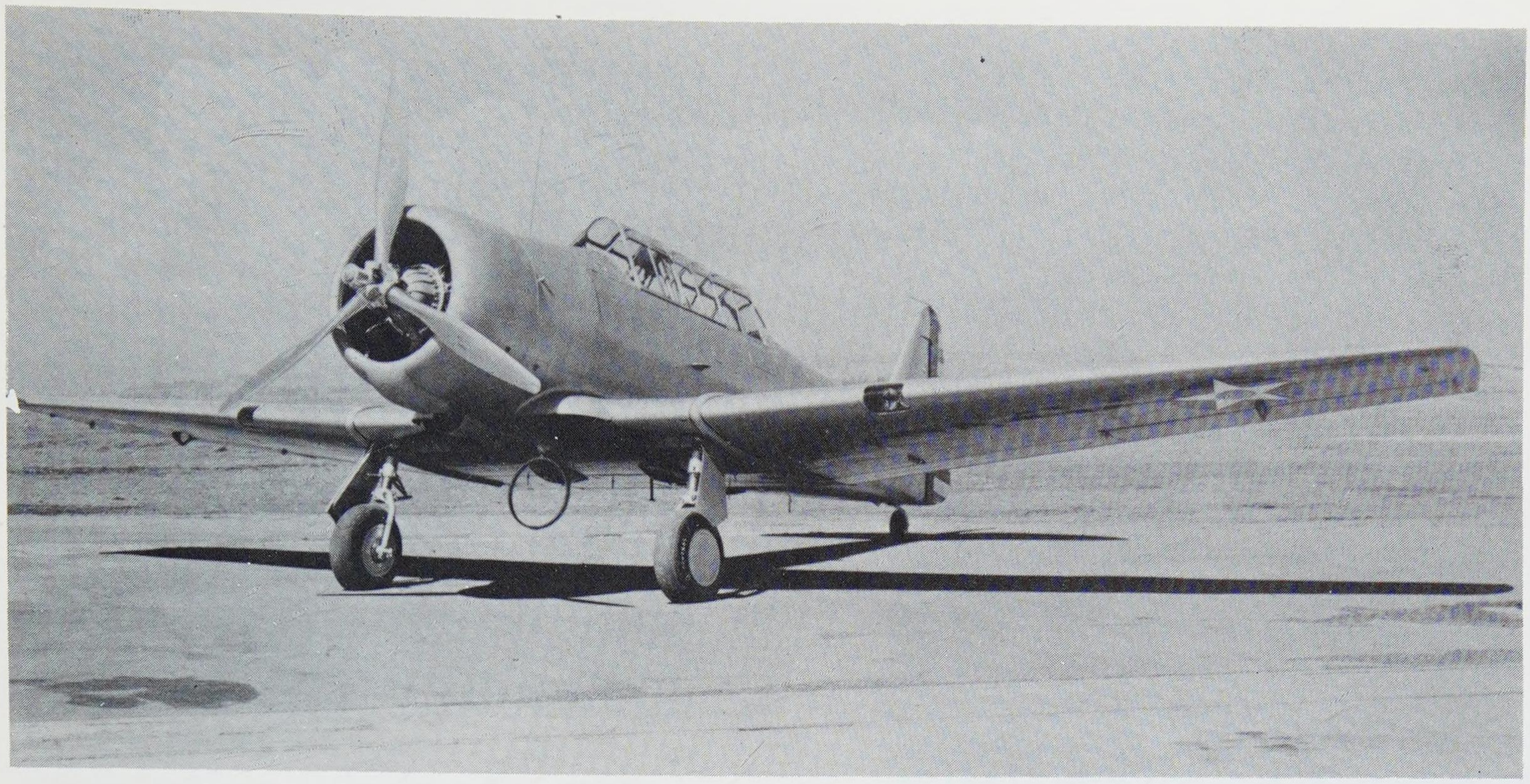
The NA-16-3 became the NA-32, the second prototype shipped to the Royal Australian Air Force to become the commonwealth-built Wirraway. Four bombs are suspended from racks on the center section. Note the beared engine, three-blade propeller, rounded rudder, and particularly the wrinkled fabric on the removable access panel below the front cockpit.

peller. The **Harvard** also had fabric-covered sides, but the aft fuselage pan was metal for protection during taxiing. These airplanes were produced as the model NA-49, and on a second contract in 1939 it was produced as the model NA-61. These two contracts totalled 400 aircraft, all of which were crated at the Inglewood plant and shipped to an assembly plant in England. Another 30 **Harvards** were delivered to the Royal Canadian Air Force in 1939 as the next training step from the **Yale.**

North American Aviation was moving ahead and in 1938 developed a new Basic Combat trainer, its NA-54 model, three of which were ordered by the Air Corps as the BC-2. The BC-2 was powered with an R-1340-45 engine with a three-blade propeller, featured all metal construction, squared wing tips, triangular vertical tail, and many other improvements. Evaluation of the BC-2 saw the transfer of its design innovations and improvements into the BC-1A of 1939 and 1940, North American's NA-59. Wing span was 42 ft. 7 in., the same as on the BC-1, but wing area was increased by squaring off the wing tips. An order was placed for 92 of the BC-1A airplanes, but nine were assigned as Advanced Trainers and given the designation AT-6. Meanwhile, the center section of one BC-1A was narrowed by seven inches to give an overall span of 42 ft. 0 in., and this sole airplane became the BC-1B. The aft fuselage was metal monoco-



One of the original versions of the Harvard, **RAF** serial 1326, was referred to as Harvard I after a Harvard II came into being. It has the squared-off rudder, fabric sides, and rounded wing tips.



North American BC-2, AAC 38-448, forerunner of the Texan. Note that the BC-2 had a gearing engine and three-bladed propeller, and a different air scoop under the nose.

que construction while the forward half was welded steel-tube framing with removable side panels.

North American set new records for production by delivering 60 airplanes for both August and September, 1938. By early 1939 there were six different models in production.

In late 1939 the British elected to concentrate their training activities in Canada under the Empire Air Training Scheme, and to have the **Harvards** flown directly to the Royal Air Force training centers being set up in the Dominion. In accordance with the U. S. Neutrality Act then in effect, in early June of 1940 the first of these **Harvards** was flown to the Canadian border and landed on an adjacent strip and was pushed across the line to waiting RAF pilots. This process

North American Harvard II serial 2501, ready for flyaway delivery to the Royal Canadian Air Force. Note the dummy gun muzzle in the starboard wing, the installation of which was variable.

became rather impractical and furthermore absurd after a while, and the U. S. State Department later amended the regulations to allow the company's delivery pilots to ferry the **Harvards** all the way. The 1000th **Harvard** came off the North American line on March 18, 1941 and was the 570th **Harvard** delivered flyaway to Canada.

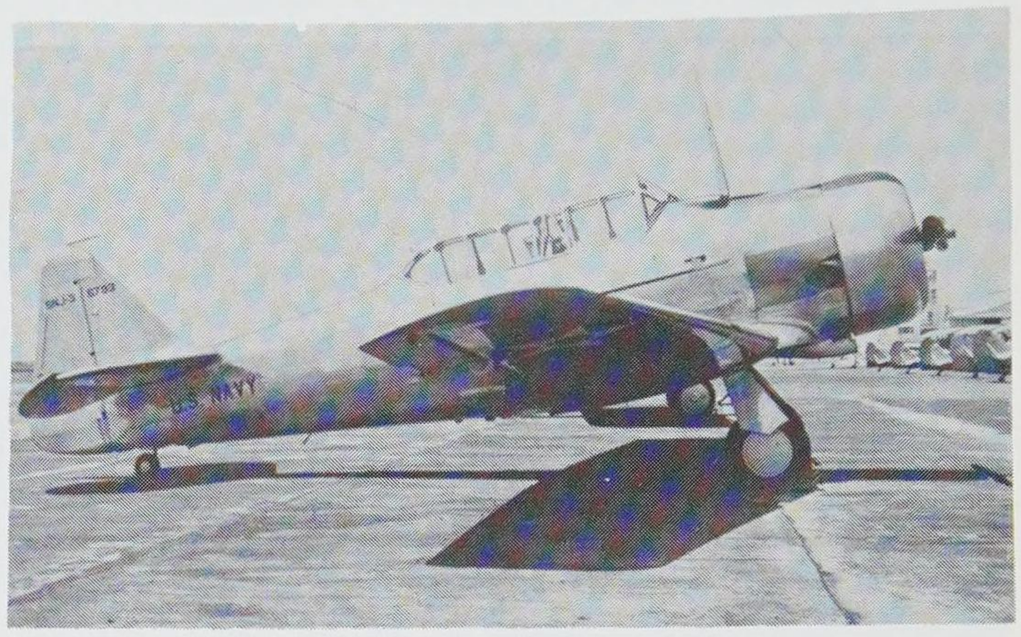
About this time the Army Air Corps made a decision to abandon the Basic Combat category and subsequent aircraft were procured as AT-6's. Including the nine transferred from BC-1A production, a total of 94 AT-6's were acquired. Hence, the AT-6, as it is generally recognized, is the BC-2 modified through the BC-1A.

One of the first group of AT-6's was assigned to the 36th Pursuit Interceptor Squadron at Mitchel Field, Long Island to train fighter pilots for night flying. Some of the production AT-6's were designated as AT-6A in 1940 because of the new Pratt & Whitney R-1340-49 engine and removable wing tanks. In 1941 a contract was let for 517 AT-6A models with the lesser 42 ft. 0 in. wing span, the production version of the BC-1B.

This SNJ-2, BuA 2040, was assigned to NAS Anacostia, Maryland. The SNJ-2 had the squared-off BC-1 rudder.

The Navy placed further orders for the for the airplane in 1940 based on the BC-2 and BC-1A, and 59 airplanes were delivered as the SNJ-2. These were similar to the AT-6 but, for some obscure reason, the SNJ-2 had the squared-off rudder of the BC-1 and **Harvard.** And, again, in keeping with the internal peculiarities of North American Aviation, the SNJ-2 was carried on the books as the NA-65 model. All Naval Reserve Air Bases had at least one SNJ-2 for instrument training.

Accelerated pilot training in the United States because of the European and Asian wars saw an immediate surge of orders for the AT-6A. The Air Corps placed a contract for 517 AT-6A's in 1941 to be powered with the R-1830-47. The Navy likewise ordered the same airplane as the SNJ-3.



The SNJ-3, BuA 6793 seen here in 1941, generally duplicated the Army's AT-6A.

The primary difference between the AT-6 and SNJ, and through all subsequent models, lay in the fact that in the SNJ's the airframe, nuts, bolts and rivets were zinc-chromated to protect against salt-air corrosion, and the SNJ's also had lights beneath the wings.

A second contract was issued in 1941 for 1032 AT-6A trainers to be built at North American's new plant in Dallas, Texas. Out of this production some went to Canada and other Allied nations. By now, too, British, Chinese, Dutch, and Latin American military pilots were being trained in the United States. The Texas-built AT-6A's employed the R-1340-49 engine with a controllable-pitch propeller. Those diverted to Canada became known as the **Harvard II,** company

The Noorduyn Harvard II A, AJ832, in RCAF colors and markings. Note that the exhaust pipe extends to about the mid-chord line over the wing.

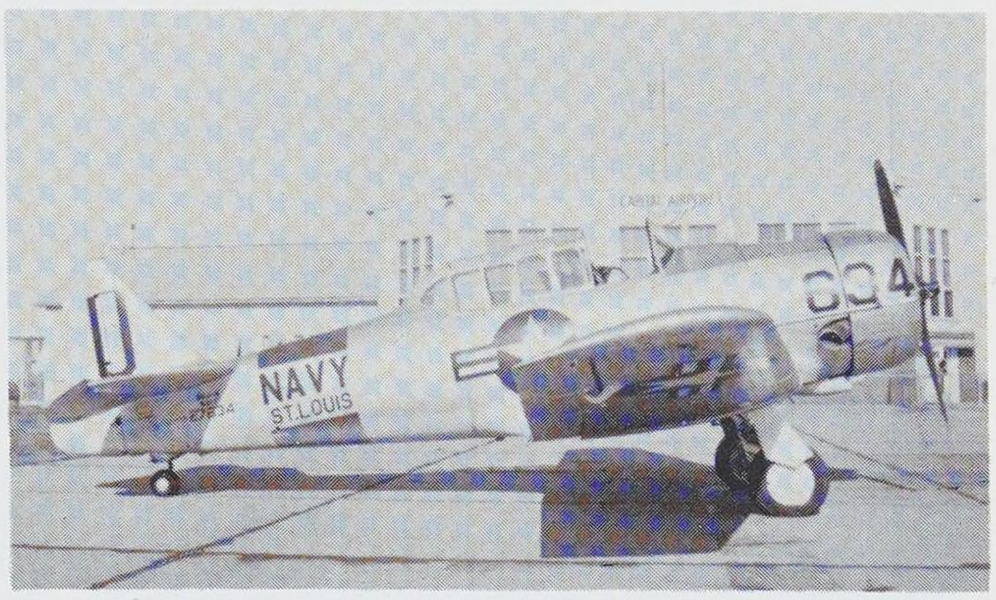
A Harvard II, number H-68, of the Royal Belgian Air Force.

model NA-66. Production of the **Harvard II** was then moved to Canada in 1942 where it was placed in licensed manufacture by Noorduyn Aviation Company, Ltd. as the **Harvard II A.**

The **Harvard II A** was designated as the Noorduyn AT-16 by the Army Air Corps and they were built under a U. S. contract, and the 1500 AT-16's had Army Air Corps serial numbers. These Noorduyn-built versions differed from the North American **Harvard II** in having a different landing gear, long exhaust pipe extending over the wing to provide better winter heating for Canadian operations, different control sticks and power settings. The fairings alongside the landing-gear struts were eliminated on the **Harvard II A.**

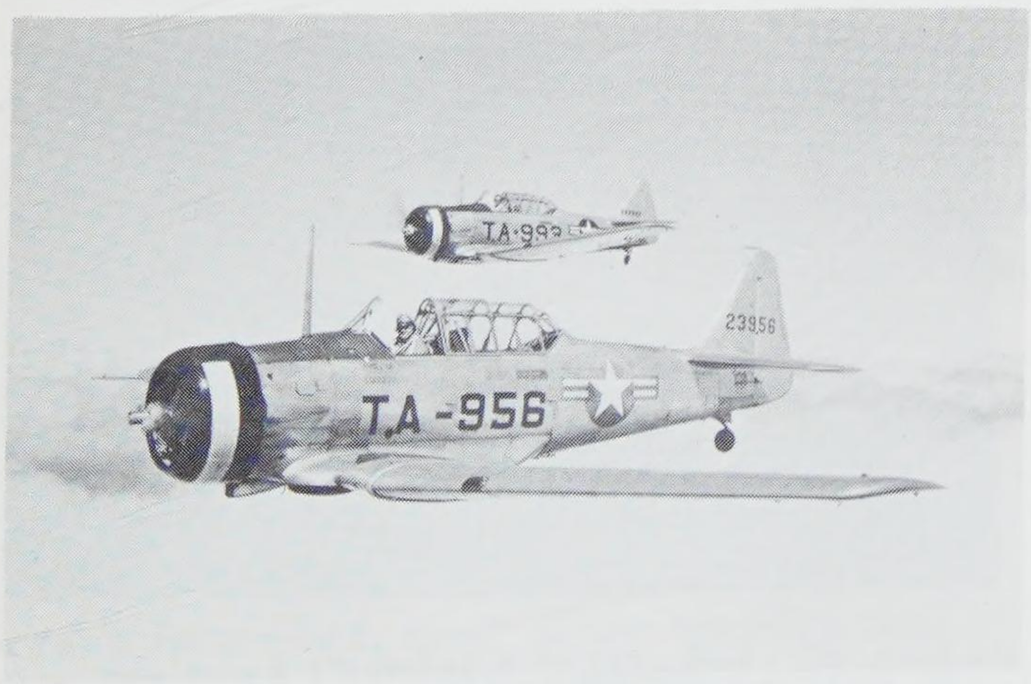
The AT-6B, 400 of which were ordered in 1941 from the Dallas plant, were the same as the Inglewood-built AT-6A but equipped with a flexible .30-cal. machine gun in the rear cockpit for gunnery training. It, as well as other models, towed target sleeves for gunnery practice. The R-1340-47 engine was standardized as the R-1340-AN-1, "AN" denoting Army-Navy standardization, and all subsequent **Texan** production utilized this powerplant.

Conservation of strategic materials was a controlling element in the AT-6C whereby plywood replaced the removable aluminum side panels and low-alloy steel employed in various components, replacing a total of 1246 lbs. of aluminum in each airplane. The contract was for 2970 airplanes delivered in 1941 and 1942. The Navy got 1425 of them as the SNJ-4, procured under the Army Air Corps contract.

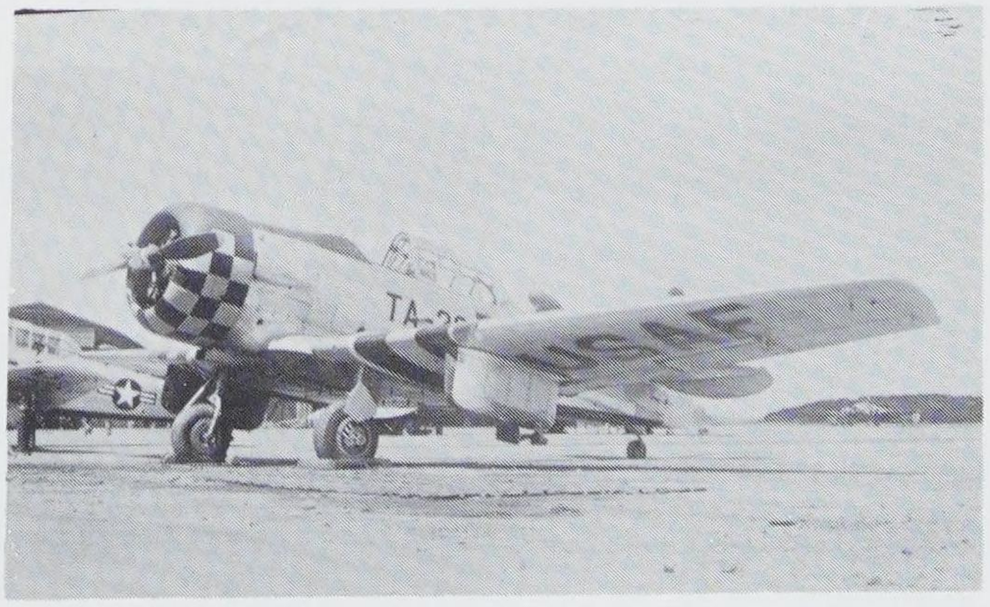


An SNJ-4, BuA 26734, still in Navy service at the end of 1953, assigned to NAS St. Louis, Missouri. The SNJ-4 had the plywood side panels as did the AT-6C.

The biggest order came with a 1942 contract calling for 4388 trainers, these to be the AT-6D-NT. By this time a manufacturer's code was usually included in the designation, in this case "NT" meaning that it was built by North American at the Texas plant. It apparently wasn't such a good idea to substitute materials in the AT-6C, and aluminum alloy went back into the airplane as well as a 24-volt electrical system. The Navy purchased 675 from the Air Corps as the SNJ-5, and most of the contract's production went to the Allies under the Lend-Lease Act.



A pair of AT-6C's, AAF 42-3956 and 42-43993. (W. T. Larkins Photo)



A T-6D, AF 42-85260A, seen in Korea where it was used for insect spraying.

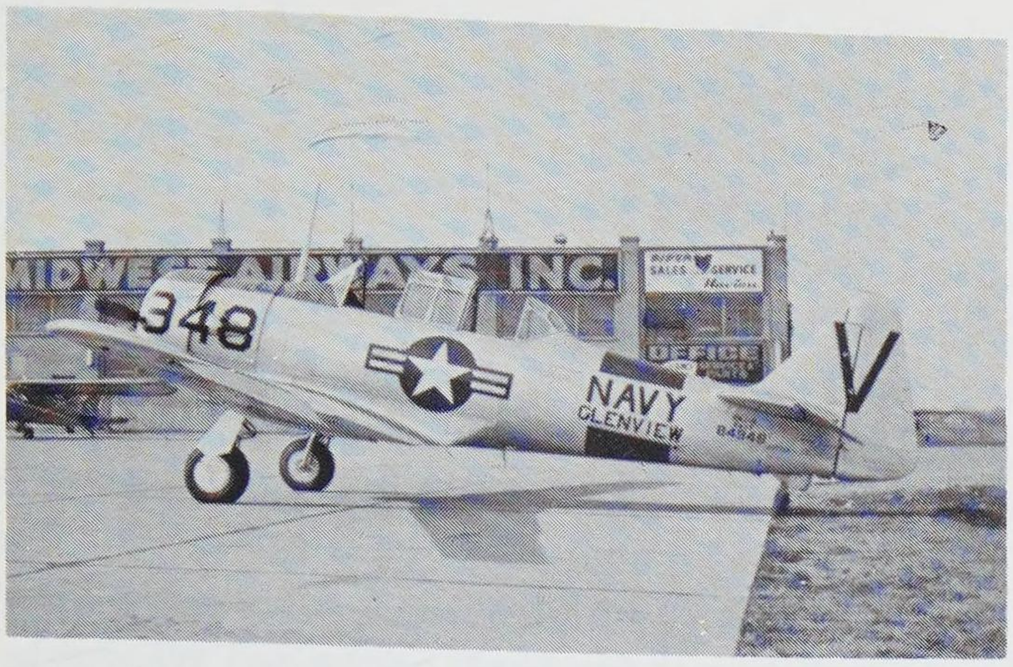
A Royal Air Force cadet warms up his AT-6B at a Southwest Airways training school. By this time, RAF students were being trained in the United States as well as in Canada, but the RAF did not have a Basic Training stage although the RCAF did.

The Navy usually had one or two SNJ's aboard the carriers for utility and courier use. There were fitted with carrier arresting hooks as were those flown from the two training carriers--the **U. S. S. Sable** and **U. S. S. Wolverine,** refurbished paddle-wheelers operating in Lake Michigan during World War II.

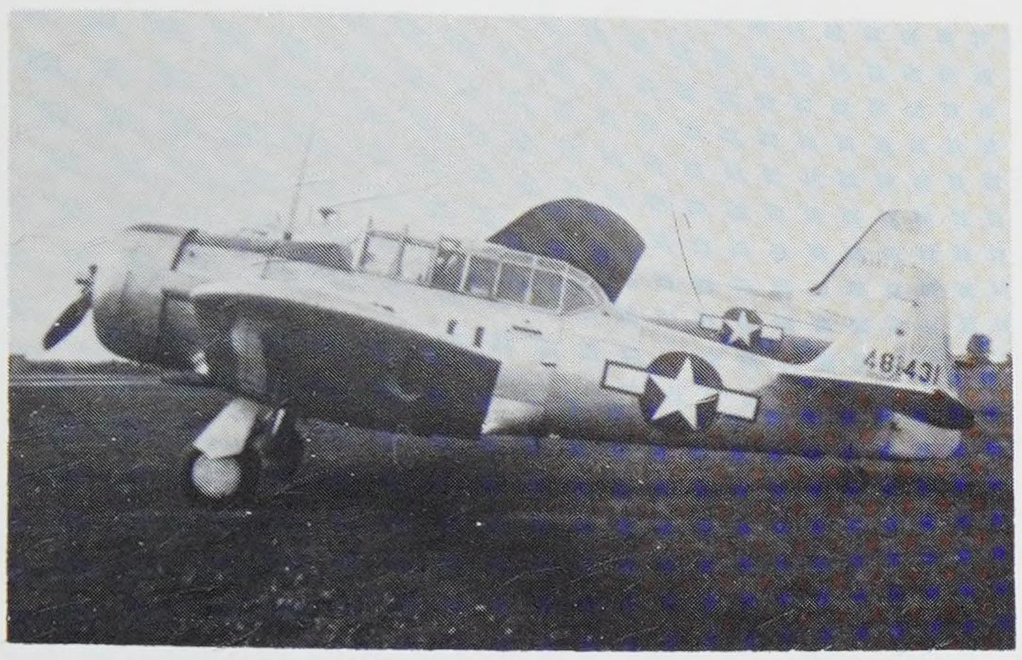
An attempt to improve the airplane at high altitude came in 1944 with the XAT-6E which saw a 575-hp Ranger V-770-9 inverted-vee engine mounted in an AT-6D. More than 30 m.p.h. was gained on the top speed and the airplane could really move as was shown when it appeared in the 1947 Halle Trophy Race for women pilots. The overall length was increased to 31 ft. 1 in. compared to the standard 29 ft. 0 in. length. However, the Ranger did not have the stamina of the Pratt & Whitney, and the project was dropped.

The last wartime effort to improve on the airplane came in 1944 and 1945 with the AT-6F wherein the design was revised and gross weight upped by 200 lbs. to 5500 lbs. Of

An SNJ–5C, 1–E–222 of Argentina's Aviacione Naval, where it served as a trainer. The Argentine Navy also had an attack squadron outfitted with this type.



An SNJ-5, BuA 84948, attached to NAS Glenview, Illinois.



North American AT-6D, AAF 44-81431. In the AT-6D, the electrical system went to 24 volts, and the use of non-strategic materials was eliminated.

the 956 airplanes produced, 931 went to the Navy as the SNJ-6.

Right after V-J Day the government declared the great majority of the training airplanes surplus and the **Texans,** along with others, could be acquired at a low fraction of their original cost. Even with their high fuel consumption, the low initial cost and parts availability made them popular with some ex-military pilots, at least those who could afford them. Many went to National Guard units and some went to rebuild the decimated air forces of friendly countries.

In the second half of 1945, 500 assorted **Texans** were allotted to the Royal Air Force, and it is presumed that these became the **Harvard III.**

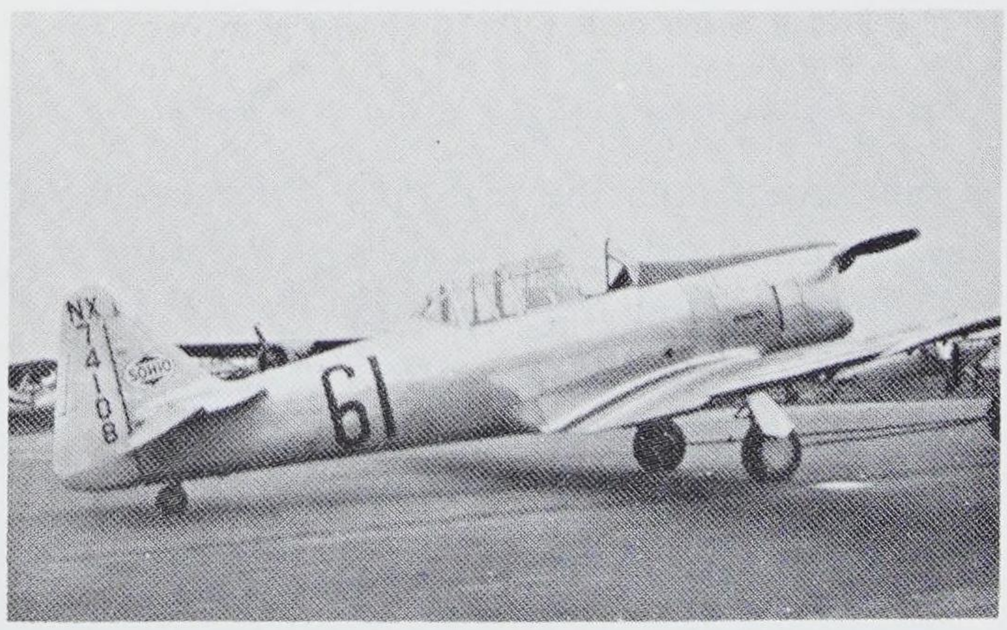
As the need for licensing and overhaul became apparent, along with an economic recession and as marital status for the veterans increased, most of the surplus civil AT-6's were put out to pasture for lack of money to maintain and operate them.

The "Cold War" brought home the realization that the United States was a bit hasty

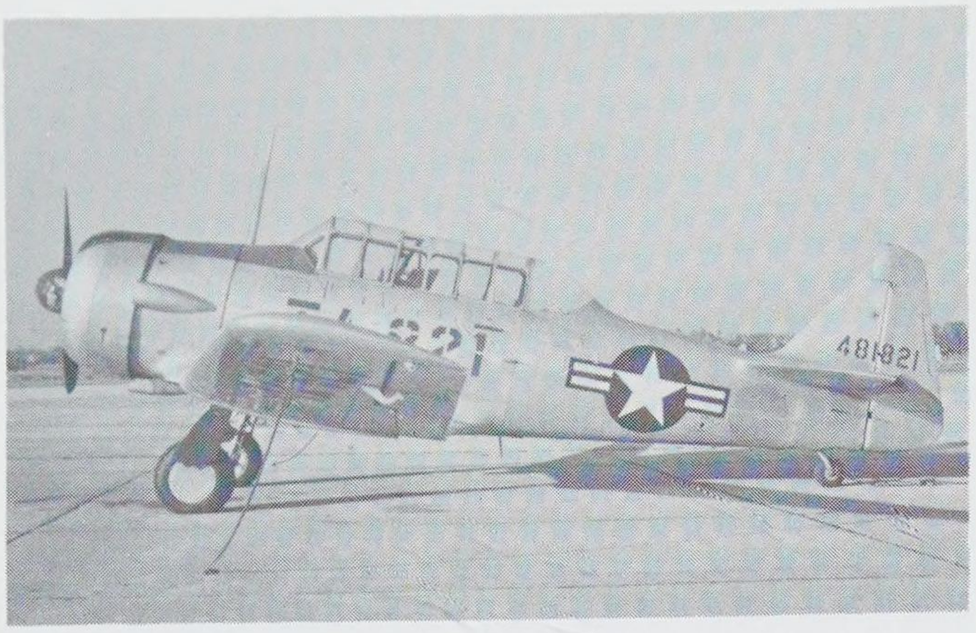
This AT-6D, ex AAC 42-95934, became S2-136 of the Aeronautica Militare Italiano following revitalization of that country's military services.

in disposing of most of its airplanes. There weren't enough of the new-generation trainers such as the T-28 and T-33 available for the accelerated training programs gone into effect and, besides, these new trainers were far too costly and sophisticated for training new students. The old categories of PT (Primary Trainer), BT (Basic Trainer), and AT (Advanced Trainer) were combined into a single Trainer classification and these designations were eliminated and superseded by the plain "T" designation. Hence, the AT-6's became T-6's, etc., as the P-51's became F-51's, etc. The Navy, however, retained the SNJ designations.

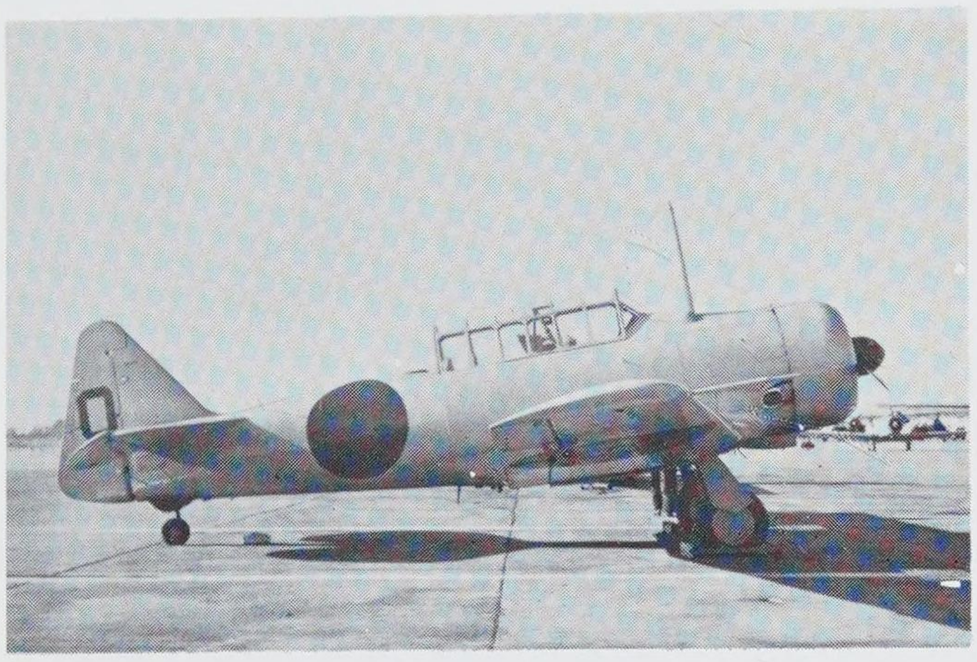
The new training concepts were found to be impractical for getting the job done. No longer was the fledgling student to be placed directly in the T-6 as had been the case for



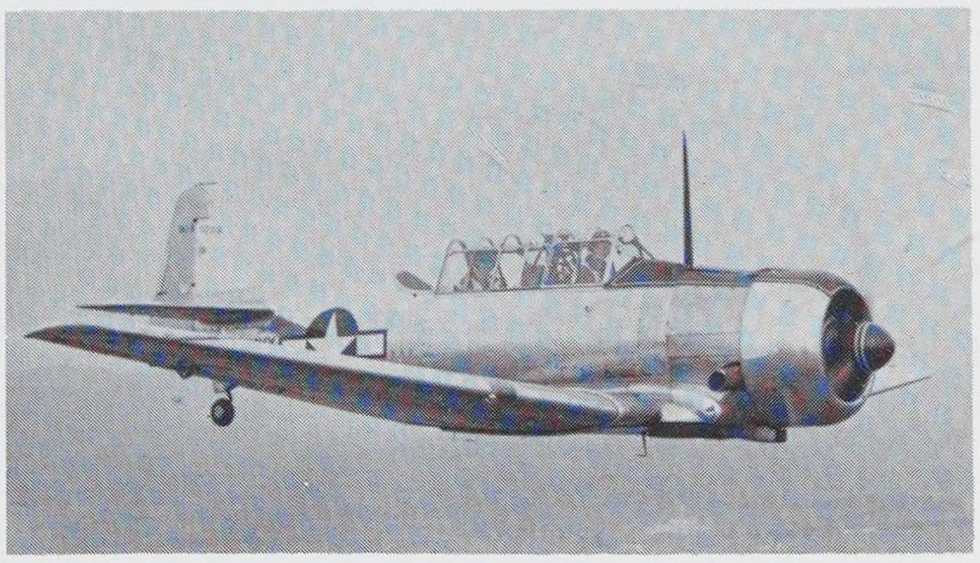
The XAT-6E was powered by an inverted-vee Ranger engine, and was much faster but not as dependable. The airplane is shown here as it appeared in the 1947 Halle Trophy Race.



North American AT-6F, AAF 44-81821. Note that the aft section of the "greenhouse" is a frameless molded piece.



Bearing Japanese insignia, this SNJ-6 was used in the late 1940's to represent a Zero in the early days of the Navy's "Blue Angels" precision-flying time.

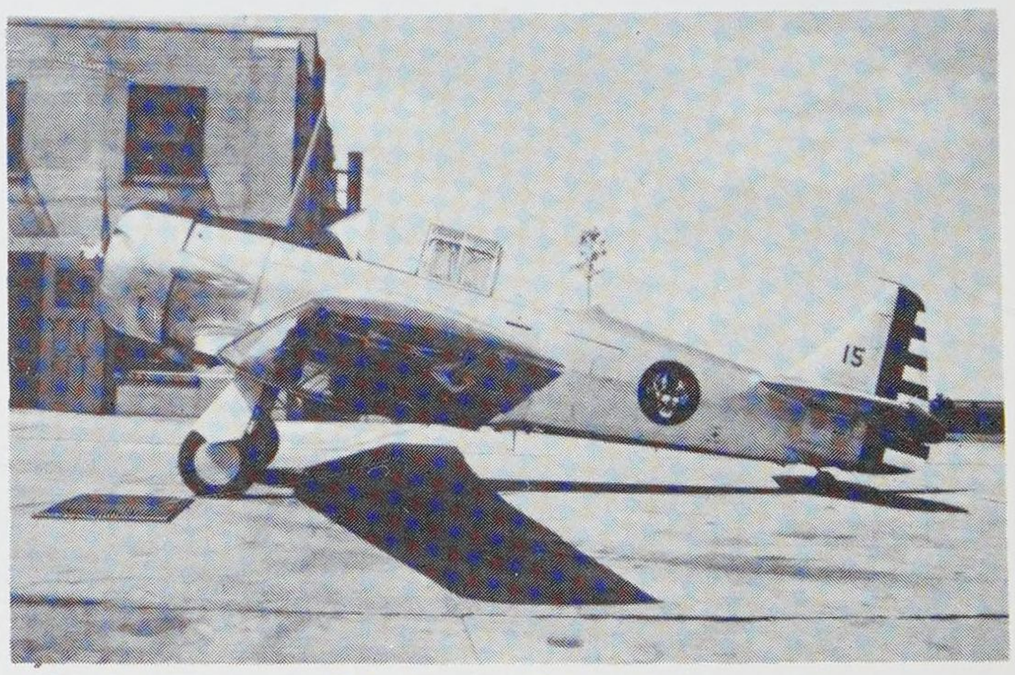


The SNJ-6, with BuA 112318 shown here, was the Navy's counterpart of the AT-6F and was, in fact, the Army Air Force AT-6F taken over by the Navy.

a few years, and the airplane reverted to an intermediate training stage with primary or initial training being done in Piper PA-18's at contract schools. Furthermore, there was by this time an acute shortage of T-6's as well as allocations to develop and purchase new training aircraft.

North American and the U. S. Air Force (the Army Air Forces had now become the separate USAF) got together in 1949 with a plan to upgrade the old AT-6's into new airplanes. Old airframes were utilized and the company had to go into the countryside to buy up both active and inactive surplus AT-6's from private parties at prices well above those paid for the airplanes when bought surplus. These airplanes were rebuilt so extensively they were considered new airplanes and given new serial numbers by the factory as well as the Air Force, and were redesignated T-6G. Among the changes were a new cockpit layout, standardization of controls and instruments for both cockpits, steerable tailwheel, P-51 type landing gear, increased fuel capacity, square-tipped propeller, repositioned radio masts, and a new less-

An AT-6A, ex AAF 41-16288, being ferried from the surplus-disposal depot by its new private owner in 1946.



North American BC-1A, AAC 39-820 seen here, became the AT-6 when the Basic Combat category was eliminated.

obstructed canopy. Propeller spinners were variable, but common. The RCAF also decided to refurbish some of their **Harvards,** and together some 2068 airplanes were converted to T-6G specifications during 1949 and 1950. These Canadian airplanes became the **Harvard IV.** The Navy also rebuilt some of their SNJ's to the comparable extent, and they became the SNJ-7.

All of the T-6G's were painted yellow overall, most going to contract training schools where both USAF and foreign students were

trained, and many were assigned to Air National Guard units for various training purposes.

In 1950 some T-6F's were shipped to Korea to fly Army observers at low levels over the front lines to spot troop movements or opportune targets for air or artillery attack. There "mosquitos," as they were dubbed, proved highly successful and, before the war ended, they were replaced or augmented by 59 T-6F's remanufactured by TEMCO, Inc. especially for such liason work and designated LT-6G. Apparently the Air Force recalled some SNJ-6's for this purpose as they never had that many T-6F's. Some T-6F's. were also remanufactured at various other locations and emerged as the T-6H model, but these were eventually redesignated as T-6G-NH models.

Even after the reconstitution of the older airplanes into the T-6G, etc., there was still a need for the airplanes and the **Harvard** was returned to production in 1952 by Canadian Car & Foundry at Fort William, Ontario, this also being the **Harvard IV** for the RCAF. The airplanes were manufactured until some time in 1954, including at least 50 new airplanes designated T-6J-CC built for the USAF but consigned to other countries under the Mutual Assistance Program. These had an empty weight of 4271 lbs. and a gross of 5617 lbs.

As far as can be determined, the United States, except for the "Mosquito" in Korea, did not employ the Texan in combat, although it was operating in combat zones. One exception was the A-27, which saw some service in 1941 in the Philippines. The A-27 was the model NA-44, ten of which were built for Siam in 1941 and then taken over by the Air Corps while enroute. These had an 8-in. wider center section and were 2 in. shorter, with a 785-hp Wright R-1820-75 spinning a three-blade propeller. The A-27 had a maximum gross weight of 6470 lbs. and net of 4241 lbs.; two .30-cal. fixed gun and one .50-cal. flexible gun in the rear, along with a 250-m.p.h. top speed.

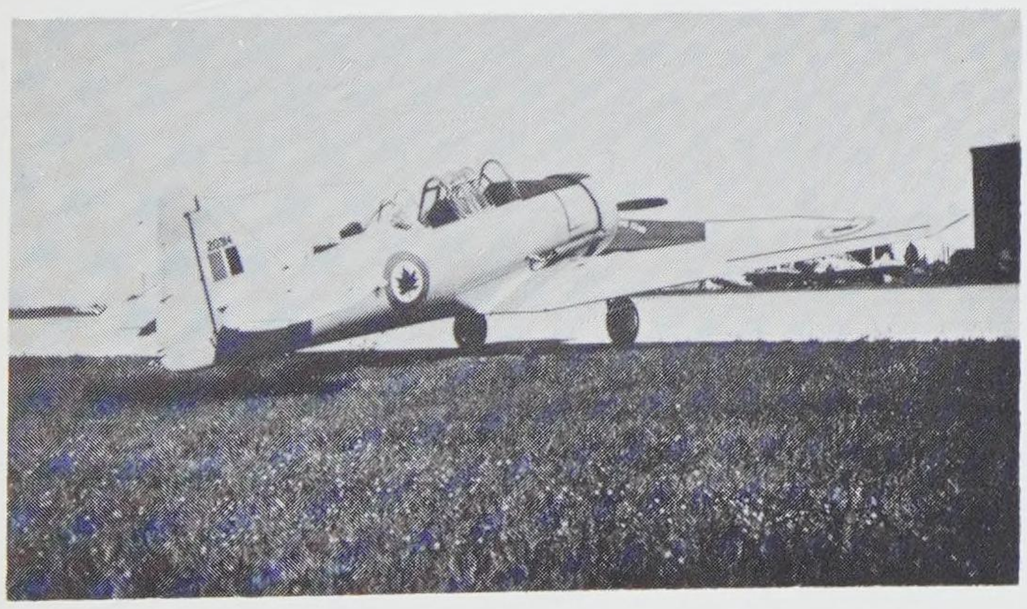
The BC-1A, **Harvard II,** AT-6B and SNJ-3 had one .303-cal. gun in the fuselage and and one flexible .30-cal. gun in the rear cockpit, and bomb racks could be fitted. The original **Harvard,** BC-1, and SNJ-1 had provisions for a single .303-cal. gun in the starboard wing, along with racks for practice bombs. Presumably, other models were or could be so fitted in the field as requirements arose. Some were equipped to carry underwing rockets and light bombs for close support.

At the outbreak of World War II it is said that the Mexican air force caught a German submarine on the surface recharging its batteries. An AT-6 dive-bombed it and sent it to the bottom.

Brazil used them for light attack bombers and as late as 1971 used **Texans** in a military aerobatic demonstration team touring South American countries.

In the Biafran-Nigerian war of secession of 1967 to 1969 the **Texan** was used for attack purposes by the Biafrans to keep the Nigerian air force busy while their smaller SAAB "Minicons" went in and raided the oil fields.

Laotian pilots flew the T-6 in combat after arming them with rockets and guns in the early 1960's. Some countries had three forward-firing guns installed along with twin guns in the rear. Most recently, in 1975, a **Texan** was used to make a raid against the Portugese presidential palace.



Canadian Car & Foundry Harvard IV, RCAF 20314, just as it emerged from the factory in 1952. The Harvard IV still utilized the older framed cockpit enclosure dispensed with on the T-6G.

Wearing the Maltese cross is this Harvard IV, AA-625 of the Deutsche Luftwaffe of West Germany.

The airplane itself was tough to taxi, easy to fly, and practically indestructible given good maintenance and frequent inspections. It was extremely noisy in all its versions, and occupants usually wore their headphones to ward off as much noise as possible. Even the British in their aircraft-spotting manuals mentioned the sound of the **Harvard** as its main identifying feature, claiming it sounded like a "noisy two-stroke motorcycle."

Fuel consumption at normal cruise is about 35 g.p.h. with a fuel capacity of 110 gals. It gets off in 900 ft. and has an initial rate of climb of 1150 f.p.m. Normal cruise is 180 m.p.h. and economy cruise is 140 m.p.h., giving a range of 500-plus miles. Stalling speed with gear and flaps down is 56 m.p.h., and it can be brought to a stop after a landing run of 700 ft. Maximum speed is in the area of 210 m.p.h.

The unit cost of the **Texan** was as follows: 1939-1941, $29,423.00; 1943, $25,672.00; 1944, $22,952.00.

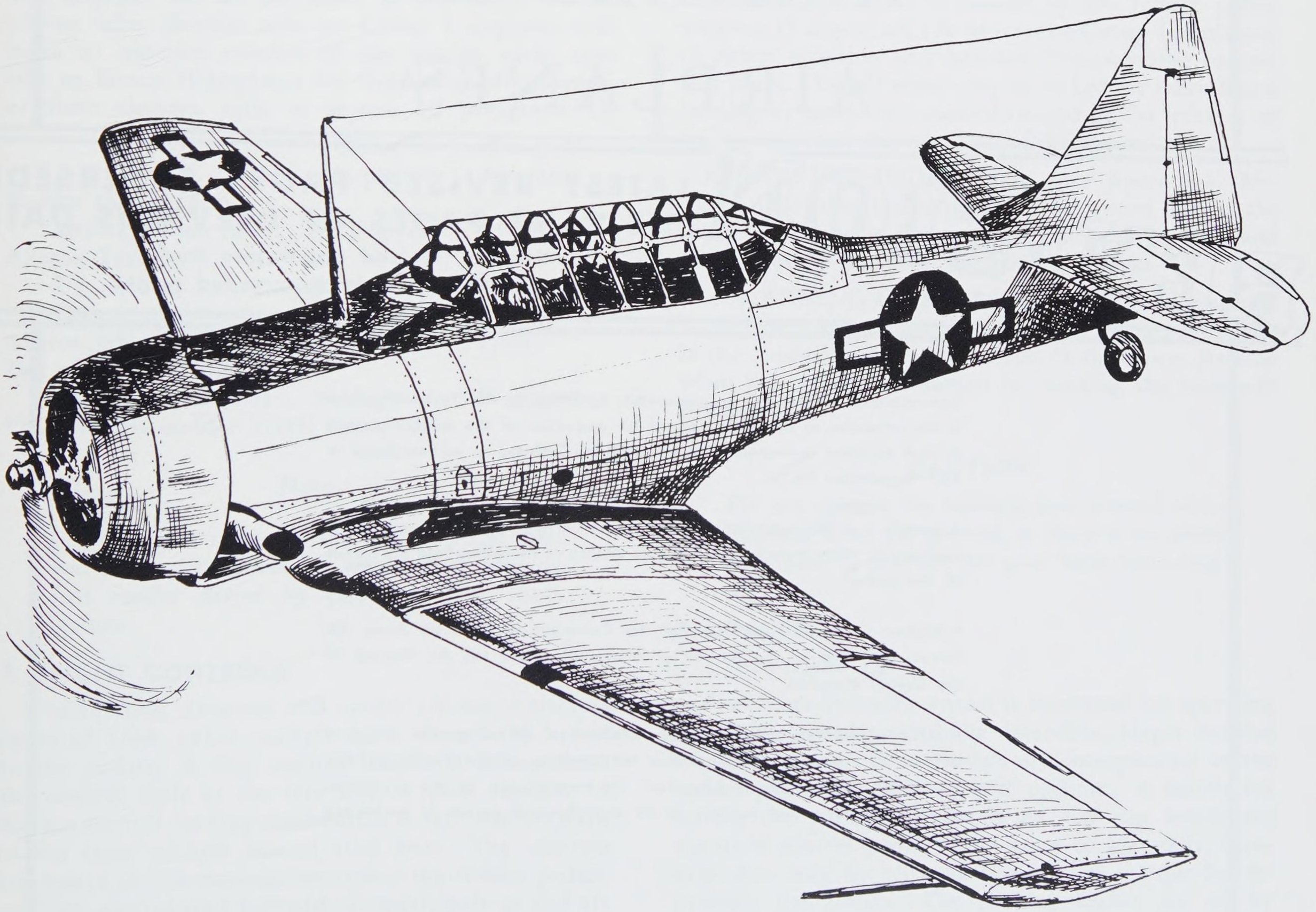
Many modifications and experiments were attempted, successfully and otherwise, by the services, conversion companies, and racing pilots. Interchangeability and adaptability of parts and components makes positive identification all but impossible in many instances.

While Kindelberger was responsible for the original NA-16 design, most of the credit for the **Texan** should go to Chief Designer R. H. Rice. Up through 1954, a total of 15,649 **Texans** and **Harvards** were turned out. Without a doubt it was the most widely used advanced trainer of the World-War-II and post-war era. As for the USAF, the T-6 went out of service in July, 1956 while the Navy continued to use them for a few more years.

Leo Kohn
May 1975

The Story of the

TEXAN



AN 01-60FE-1

PILOT'S HANDBOOK

FOR

ARMY MODEL
AT-6C

NAVY MODEL
SNJ-4

BRITISH MODEL
HARVARD IIA

AIRPLANES

REVISION NOTICE

LATEST REVISED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert revised pages into basic publication. Destroy superseded pages.

Commanding Officers will be responsible for bringing this Technical Order to the attention of all pilots cleared for operation of the subject aircraft as well as those undergoing Transition Flying Training as contemplated in AAF Regulation 50-16.

Appendix I of this publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of the enemy.

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

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SECTION I
DESCRIPTION

1. GENERAL.

AT-6C and SNJ-4 (Navy) airplanes are two-place, dual controlled, single-engine, low-wing monoplanes designed as advanced trainers with provisions for the installation of bomb carrying and gunnery equipment. The front fuselage section houses the front and rear cockpits and all the controls and equipment for operating the airplane. The baggage compartment and lift and mooring tube are contained in the rear fuselage section. The airplane has a wing span of 42 feet, 1/4 inch; a length of 28 feet, 11-7/8 inches; a height (tail up) of 12 feet, 9-1/4 inches; and weighs (normal gross) 5300 pounds.

2. DESCRIPTION OF CHANGES.

A major production change in movement of control surfaces to improve the spin characteristics of the airplane divides them into two basic groups as listed below.

The airplane can be identified by movement of the aileron tabs. Booster tabs on Group I airplanes will move in opposite relation to the aileron while trim tabs on Group II airplanes are fixed. For effectiveness of these changes, refer to section II, paragraph 13.

	Group I Airplanes	Group II Airplanes
Rudder travel (from airplane center line)	35 degrees	30 degrees
Aileron Travel		
Up	30 degrees	15 degrees
Down	15 degrees	15 degrees
Aileron tabs	Booster	Trim
Tail wheel travel (from airplane center line)	30 degrees	*15 degrees

*Tail wheel—rudder travel ratio, 2:1.

Note

On Group II airplanes the rudder pedal neutral position is moved aft one inch to provide full rudder throw by pilots of very short stature.

3. FLIGHT CONTROLS.

The ailerons, elevators, and rudder are conventionally operated from either cockpit by a control stick and rudder pedals. A flap control handle is mounted on the control shelf at the left side of each cockpit. A surface control locking mechanism is left and forward of the front cockpit control stick base. The controls are locked in this manner: neutralize the rudder pedals, push the control stick forward of center, pull up and aft on the lock handle, engage the control stick in the lock recess, and engage the lock plunger. To release, push the lock control handle forward and down. Aileron trim or booster tab adjustments are made at the tab only; rudder and elevator trim tabs are adjusted by control wheels on the left side of each cockpit. Elevator trim wheel is marked "NEUTRAL", "TH", and "NH"; rudder trim wheel is marked "NEUTRAL", "L", and "R". The rear cockpit control stick, when not in use, is stowed in a socket at the left side of the cockpit.

4. LANDING GEAR.

a. CONTROL. *(See figures 5 and 8.)*—A control lever for the hydraulically operated main landing gear is mounted on the control shelf at the left side of each cockpit. The front cockpit control has three positions, "UP", "DOWN", and "EMERGENCY" (used to manually lock the gear in the down position). This control will extend or retract the gear. Controls must remain in their "UP" or "DOWN" positions when the gear is operated as there is no neutral position. The control in the rear cockpit will only extend the gear. The nonretractable tail wheel is steered by the rudder pedals within a 15 degree arc (30 degrees on Group I airplanes) in either direction and becomes free-swiveling beyond that point. The tail wheel may be locked for take-off and landing by means of a control located on the left side of the front cockpit above and aft of the flap control.

b. POSITION INDICATOR. *(See figure 5.)*—Mechanical position indicators on the forward end of the control shelf in the front cockpit indicate the travel and position of the main landing gear at all times.

c. WARNING HORN.—A warning horn is mounted in the overturn structure above the rear instrument panel. If the landing gear is not locked in the down position when the throttle is retarded for landing, the horn will vibrate.

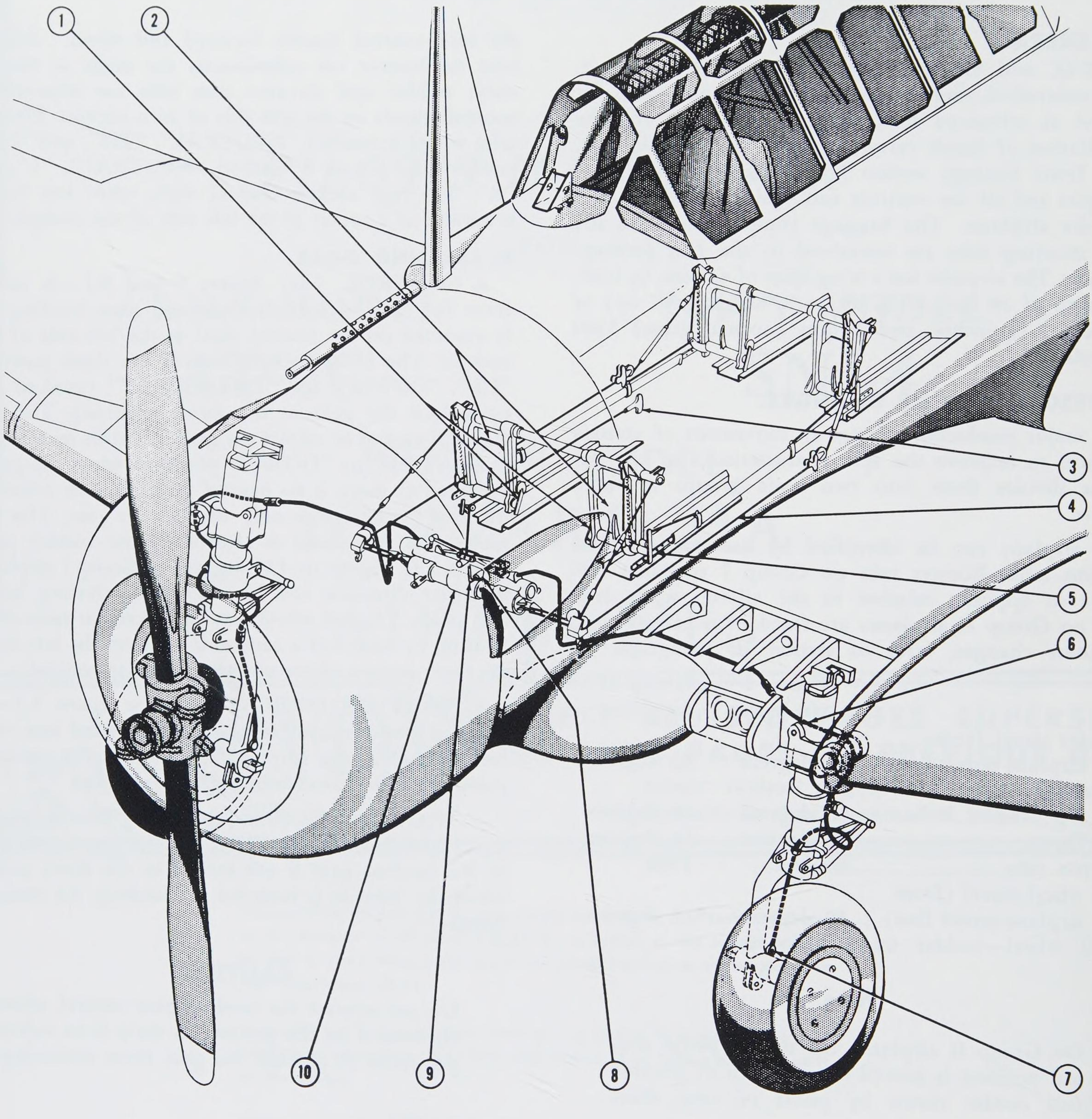
CAUTION

Do not operate the landing gear control when airplane is on the ground, as there is no safety provision to prevent the gear from retracting.

5. BRAKES.

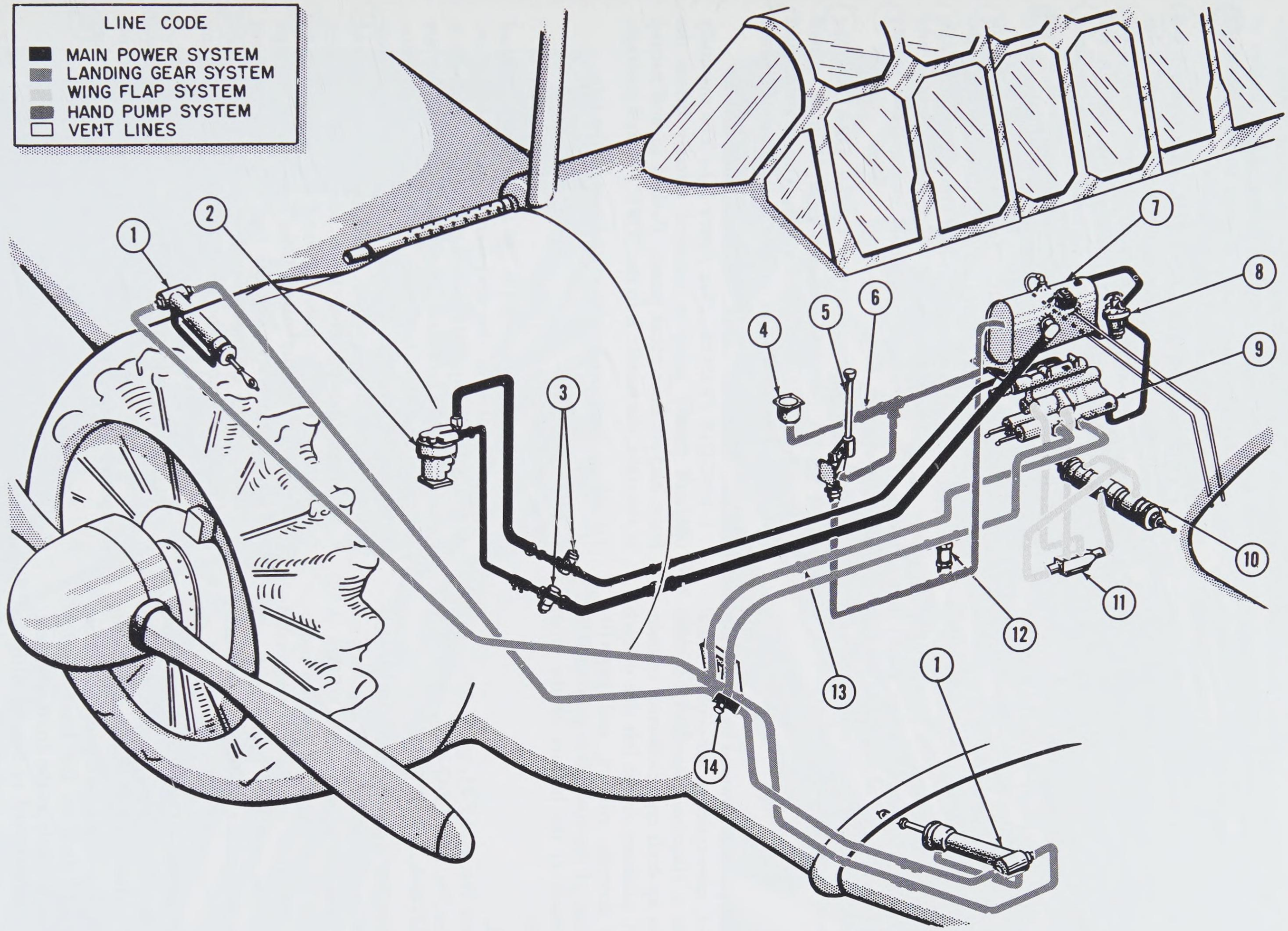
(See figure 1.)

A separate hydraulic system is employed for operating the brakes which are of the reversible, Hayes internal expanding type. Brake pedals are incorporated in the rudder pedal assemblies of both cockpits. A handle for setting the parking brakes is located just below the electrical control panel in the front cockpit only; however they may be released from either cockpit by depressing the pedals. The parking brakes are set by depressing the brake pedals, pulling out the handle, releasing the pedals, and then releasing the handle.



1. Pedal Adjustment Lever
2. Rudder Pedal
3. Parking Brake Handle
4. Brake Cables
5. Pedal Adjustment Linkage
6. Brake Lines
7. Bleeder Valve
8. Filler Neck
9. Vent Line
10. Master Brake Cylinder

Figure 1 — Brake Hydraulic System



1. Landing Gear Operating Cylinders
2. Engine-Driven Pump
3. Test Connections
4. Pressure Gage
5. Emergency Hand Pump
6. Snubber Valve
7. Reservoir
8. Filter
9. Selector Valve
10. Flap Operating Cylinder
11. Flap Ratchet Valve
12. One-way Check Valve
13. Restrictor Valve
14. Drain Plug

Figure 2 — Main Hydraulic System

6. MAIN HYDRAULIC SYSTEM.

(See figure 2.)

The main hydraulic system is provided to operate the main landing gear and wing flaps. Pressure is controlled by a power control lever on the control shelf of each cockpit; when pressed, hydraulic power is available for approximately two minutes before the control automatically disengages. Operation of the flaps and landing gear is controlled by individual levers on the control shelf of each cockpit. The flap control has three positions, "UP", "LOCKED", and "DOWN". The "LOCKED" position is used to lock the flaps in any intermediate position. It is necessary to leave the control in the "UP" or "DOWN" position when full retraction or extension is desired as there is no neutral position. An emergency hand pump, located just left of the pilot's seat in the front cockpit, is provided for emergency operation of the flaps and landing gear. A pressure gage on the forward end of the front cockpit control shelf indicates the pressure in the main hydraulic system when the power control lever is engaged.

7. POWER PLANT.

a. ENGINE.—The airplane is powered by a Pratt and Whitney R-1340-AN-1, nine-cylinder, air-cooled, radial engine equipped with a Hamilton Standard constant-speed propeller and an up-draft type carburetor containing an idle cut-off. A quadrant on the left side of each cockpit contains the throttle, mixture, and propeller control levers. Creepage of the controls is prevented by a disc-type friction clutch at the bottom of the front cockpit quadrant only.

b. FUEL AND OIL.

Fuel: Specification No. AN-F-25, grade 87
Oil: Specification No. AN-VV-O-446a, grade 1120 (S) and AN-O-5, 1100 P (W)

c. THROTTLE CONTROL.—The throttle controls on the two quadrants are linked by rods; the forward position is "OPEN", the aft position "CLOSED". A toggle-type stop on the front quadrant restricts movement of the controls so that 36 in. Hg is not exceeded at sea level take-off. The stop may be released only on the front quadrant for further throttle advancement in case of emergency.

d. MIXTURE CONTROL.—The two mixture controls are linked by rods and the positions are: forward, "RICH"; aft, "LEAN". Movement of the controls to the "LEAN" position is restricted by a spring-loaded ratchet mounted on the forward face of the front control. This ratchet can be released only at the front quadrant, thus the mixture may be enriched or leaned with the front control but enriched only with the rear control. The idle cut-off becomes effective when the controls are at the extreme "LEAN" position.

e. PROPELLER CONTROL. — The positions of the propeller controls are: forward, "INCREASE RPM"; aft, "DECREASE RPM". Movement of the controls operates valves in the propeller governor which controls the blade angle of the propeller. Blade angles of the propeller are from 11-1/2 degrees in the low pitch position to 27 degrees in high pitch.

f. CARBURETOR AIR CONTROL. *(See figure 5.)*— The carburetor air temperature control quadrant is located at the left side of the front cockpit. When the control is in the "COLD" position, the gate in the carburetor air duct is open to permit cold air entrance; when it is in the "HOT" position, the gate is closed and hot air enters from the exhaust manifold shroud.

g. STARTER CONTROL. *(See figure 13.)*—A foot pedal for electrical control of the starter is mounted between the rudder pedals in the front cockpit. Pressure on the heel of the pedal energizes the starter and pressure on the toe of the pedal engages the starter with the engine.

h. MANIFOLD PRESSURE GAGE DRAIN. *(See figure 5.)*—A manifold pressure gage drain is located on the left side of the front cockpit. This drain should be operated for 5 seconds at engine warm-up in order to expel moisture from the line.

i. ENGINE PRIMER. *(See figure 7.)*—The manually operated primer pump is installed directly below the front cockpit instrument panel. Pushed in and turned to the right, the handle is in the "OFF", locked position. To unlock, push the handle in and turn to the left.

8. FUEL SYSTEM.

(See figure 3.)

a. GENERAL—Two 55 US (46 Imperial) gallon fuel tanks are housed in the wing center section structure. A 20 US (16.7 Imperial) gallon reserve compartment is contained in the left tank. Controls for the system are comprised of a hand fuel pump handle and a fuel selector control at the left of each cockpit and an engine primer in the front cockpit. Fuel contents gages and a fuel switch-over signal lamp comprise the system instruments. Fuel is inducted into the carburetor by the engine-driven fuel pump from either tank through the fuel selector valve and the fuel unit. In the event of failure of the engine-driven fuel pump, fuel is supplied to the carburetor by the fuel unit, pressure being applied by the hand pump.

b. FUEL SWITCH-OVER SIGNAL. *(See figure 7.)*— A signal lamp on the right side of the front cockpit instrument panel will light when the carburetor fuel

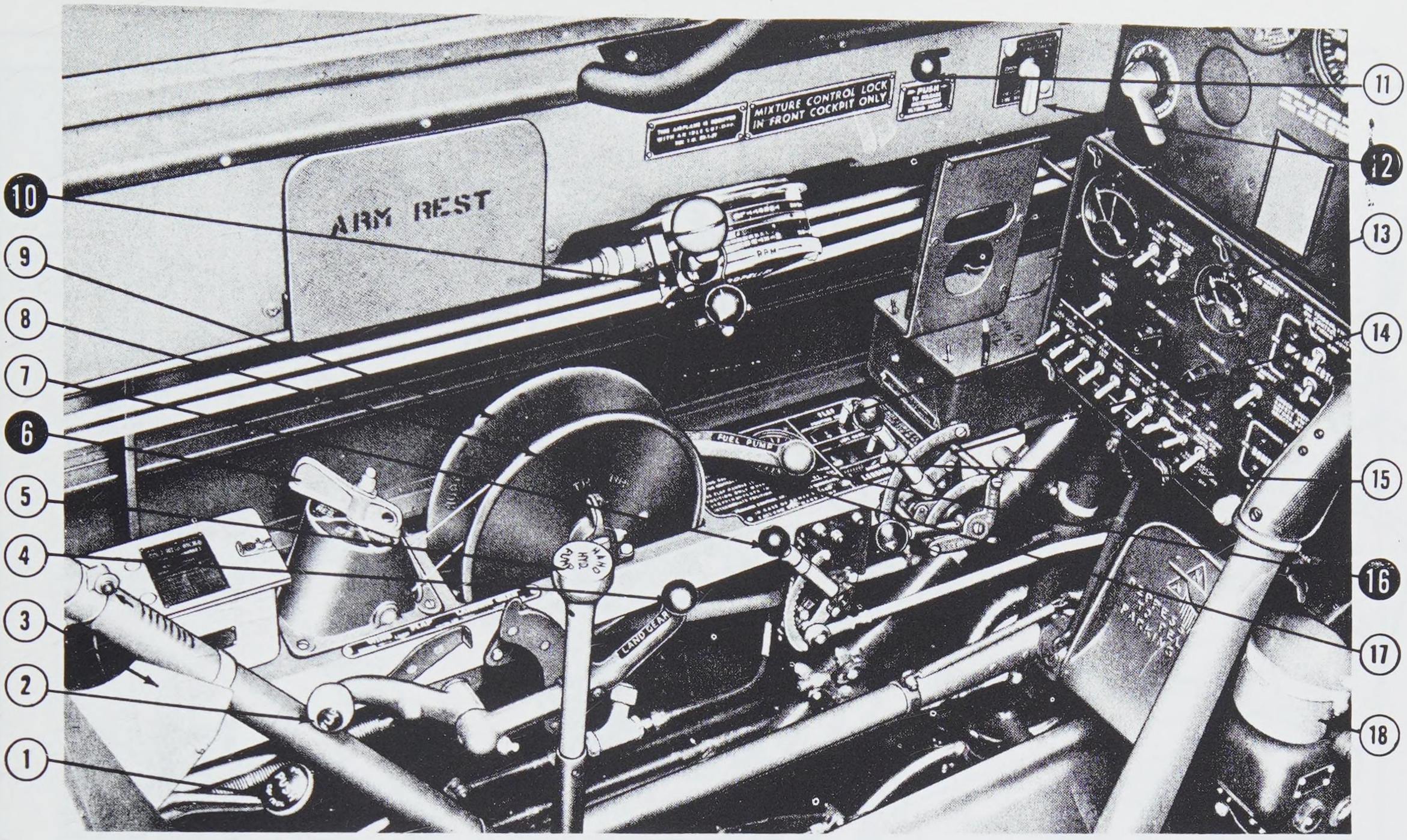


Figure 5 — Left Side Front Cockpit

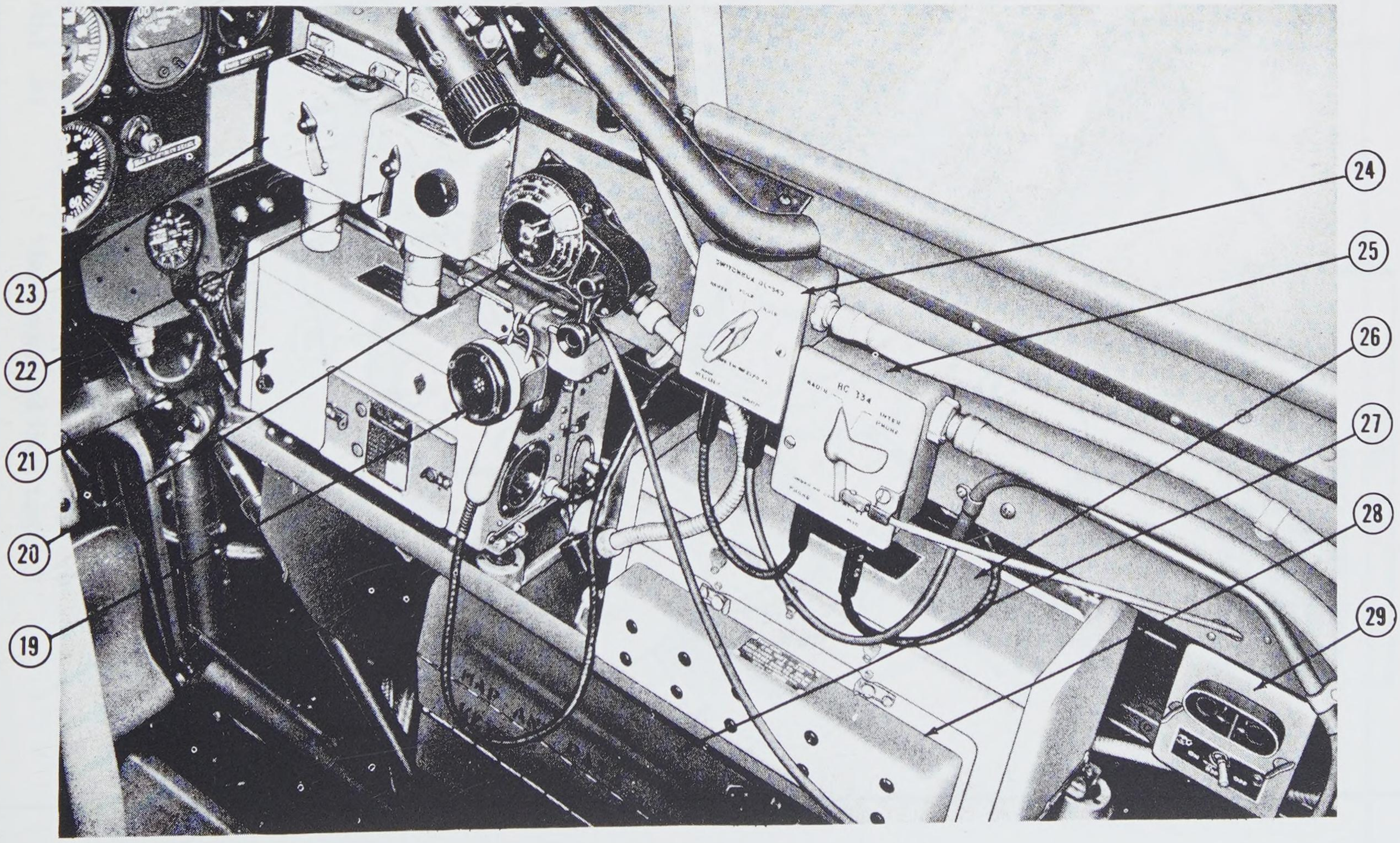
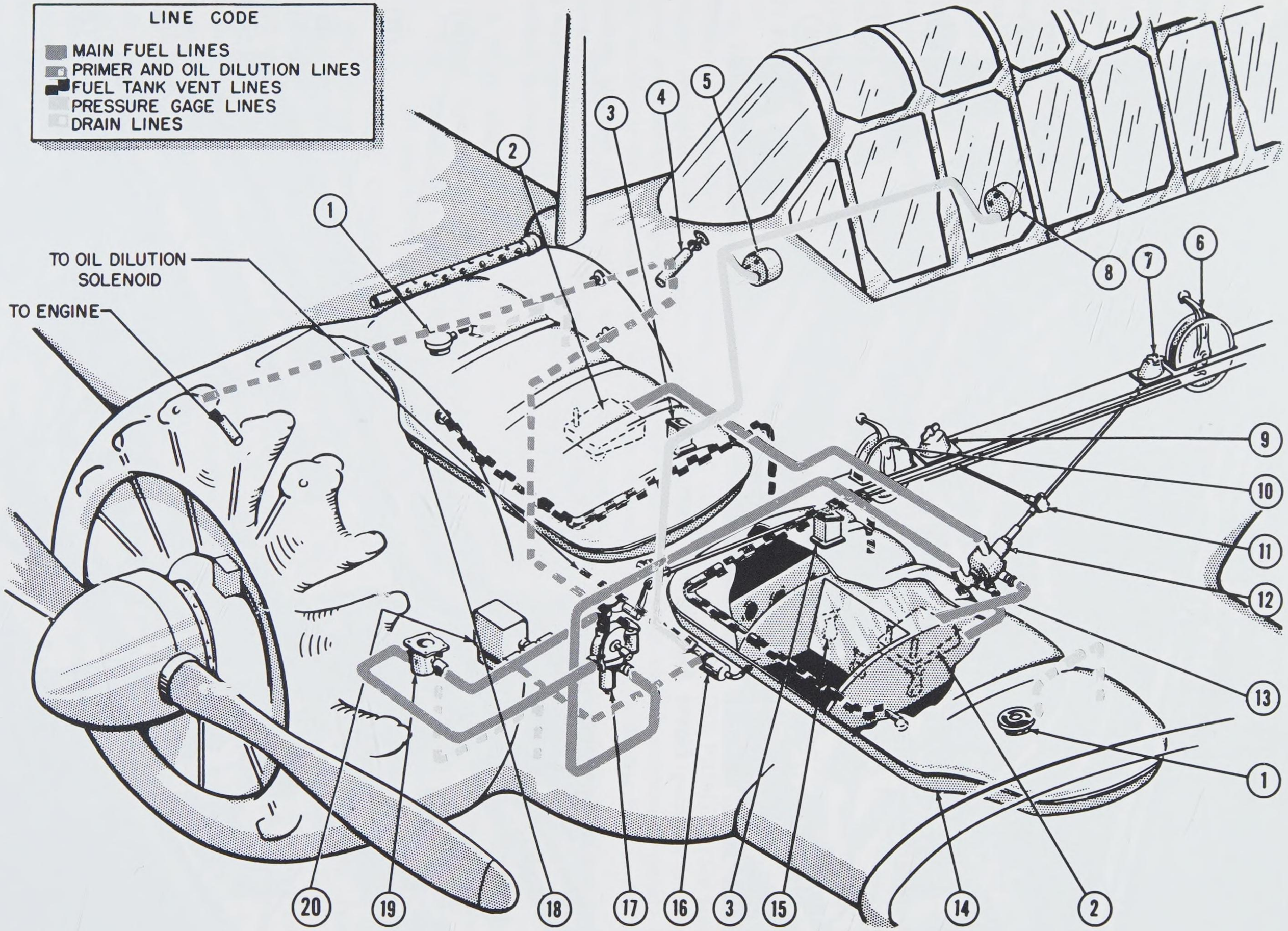
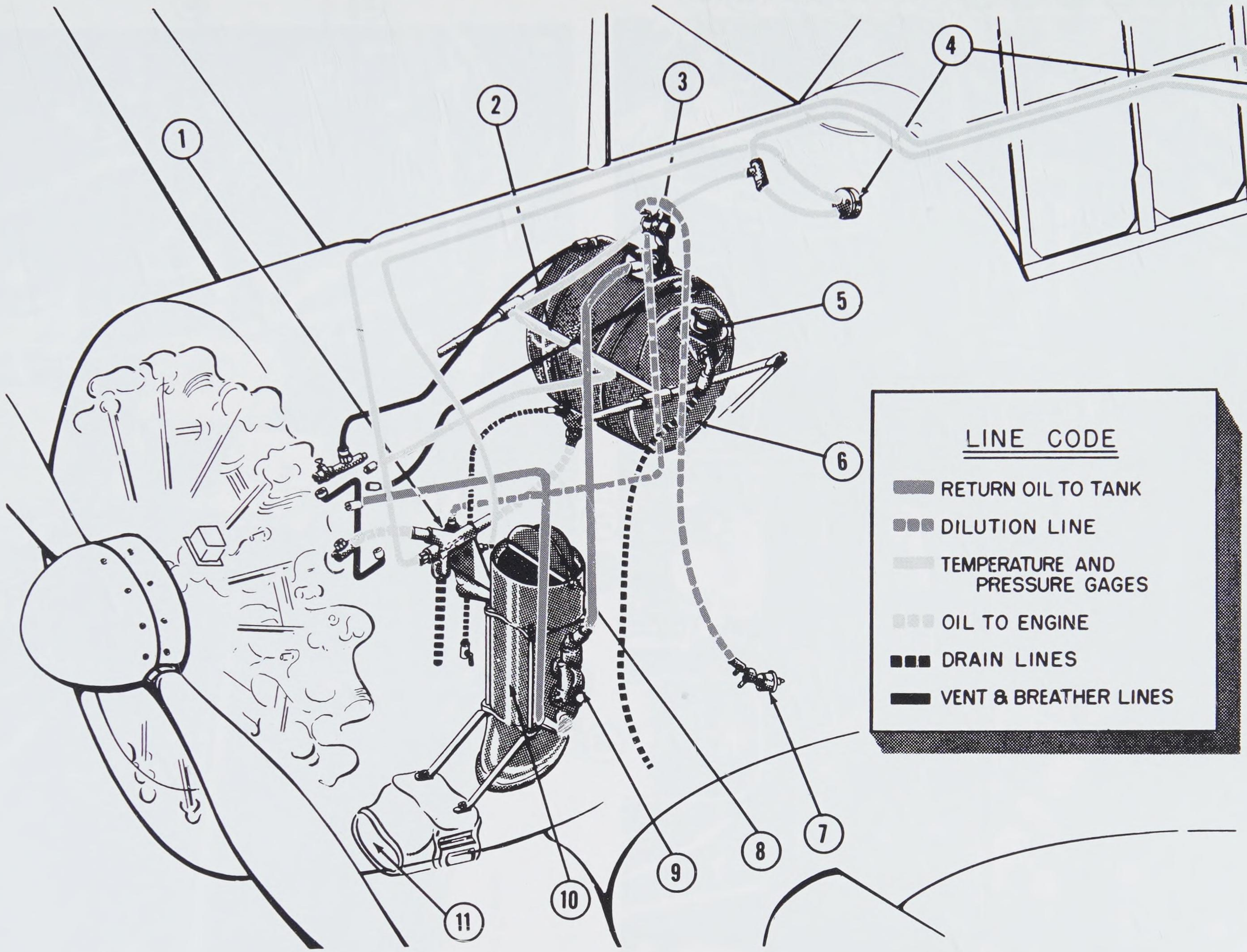


Figure 6 — Right Side Front Cockpit



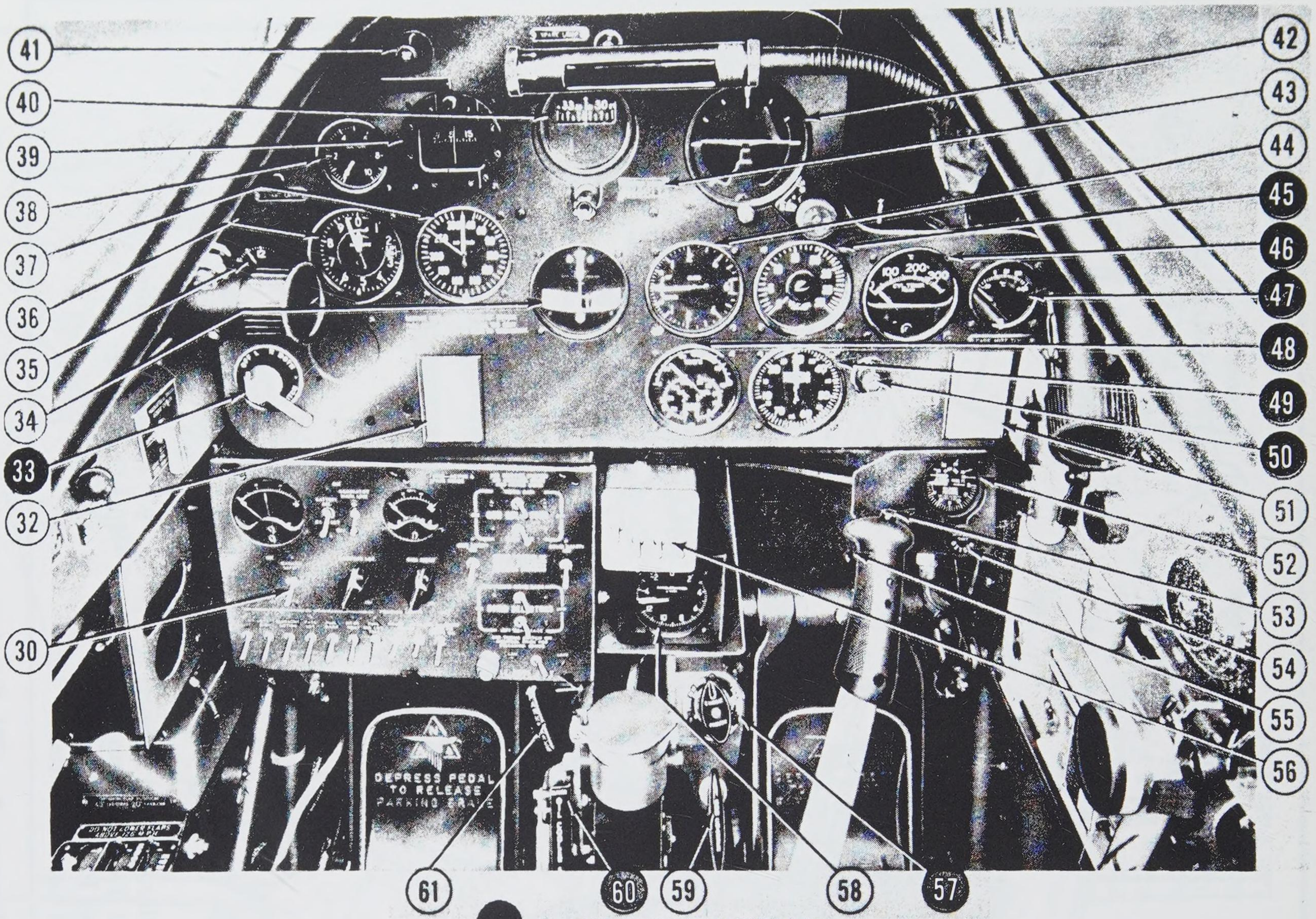
1. Filler Caps
2. Fuel Tank Sumps
3. Fuel Tank Gage Assemblies
4. Primer
5. Front Cockpit Engine Gage
6. Rear Fuel Pump Handle
7. Rear Fuel Selector Dial
8. Rear Cockpit Engine Gage
9. Front Fuel Selector Dial
10. Front Fuel Pump Handle
11. Selector Valve Gear
12. Fuel Selector Valve
13. Selector Valve Drain Cock
14. Left Fuel Tank
15. Flapper Valve
16. Fuel Pressure Signal
17. Fuel Unit
18. Right Fuel Tank
19. Engine-Driven Pump
20. Carburetor

Figure 3 — Fuel System



1. Oil "Y" Drain Valve
2. Sump
3. Oil Dilution Solenoid
4. Engine Gage
5. Filler Cap and Adapter
6. Oil Tank Assembly
7. Fuel Pressure Signal
8. Oil Cooler Shutters
9. Thermostat Relief Valve
10. Oil Cooler
11. Air Duct

Figure 4—Oil System



POWER PLANT CONTROLS

1. Hydraulic Power Control
2. Flap Control
3. Flight Report Case
4. Landing Gear Control
5. Hydraulic Hand Pump
6. Fuel Selector
7. Carburetor Air Temp Control
8. Elevator Trim Tab Control
9. Rudder Trim Tab Control
10. Engine Control Quadrant
11. Blind Flying Hood Release
12. Manifold Pressure Gage Drain Valve
13. Flap Position Indicator
14. Bomb Control Quadrant
15. Landing Gear Position Indicator
16. Hand Fuel Pump Handle
17. Hydraulic Pressure Gage
18. Gun Sight
19. Microphone
20. Receiver Tuning Dial
21. Radio Transmitter
22. Radio Receiver Switch
23. Transmitter Modulator Switch
24. Radio Filter Box
25. Radio-Interphone Selector Switch
26. Radio Receiver
27. Map and Data Case
28. Receiver Coil Unit
29. British Interphone Switch
30. Electrical Control Panel
31. Deleted
32. Altimeter Correction Chart
33. Ignition Switch
34. Bank and Turn Indicator
35. Clock
36. Altimeter
37. Air-Speed Indicator
38. Suction Gage
39. Magnetic Compass
40. Directional Gyro
41. Camera Signal Light
42. Gyro Horizon
43. Radio Call Plate
44. Rate of Climb Indicator
45. Tachometer
46. Cylinder Head Temp Gage
47. Carburetor Mixture Temp Gage
48. Oil Temp, Fuel and Oil Pressure Gage
49. Manifold Pressure Gage
50. Fuel Switch-over Signal Light
51. Compass Correction Chart
52. Oxygen Pressure and Flow Gage
53. Bomb Release Switch
54. Oxygen Regulator Control
55. Gun Trigger Switch
56. Recognition Light Switches
57. Engine Primer
58. Accelerometer
59. Gun Charger
60. Oil Cooler Shutter Control
61. Parking Brake Handle

Figure 7 — Center Front Cockpit

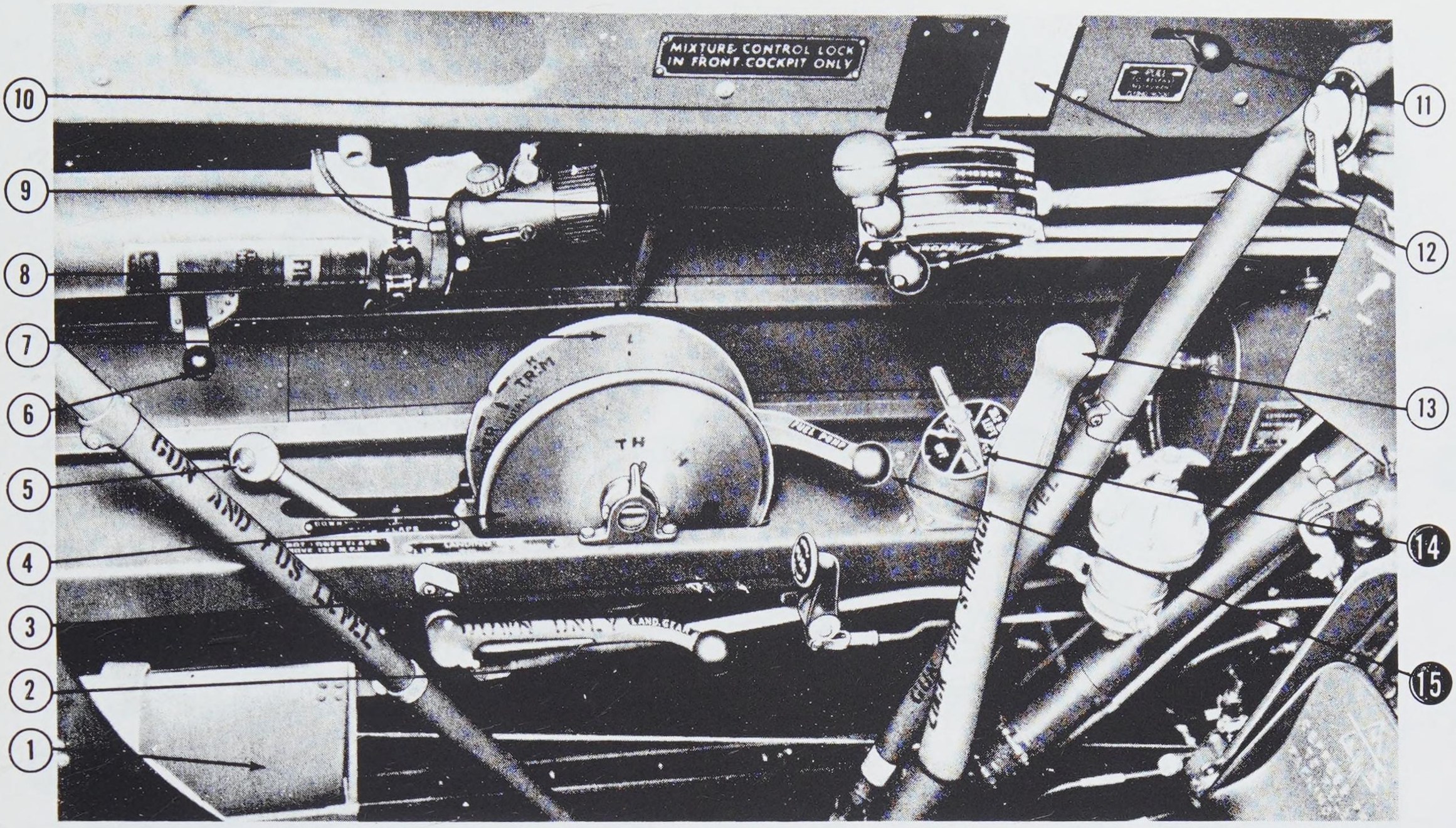


Figure 8 — Left Side Rear Cockpit

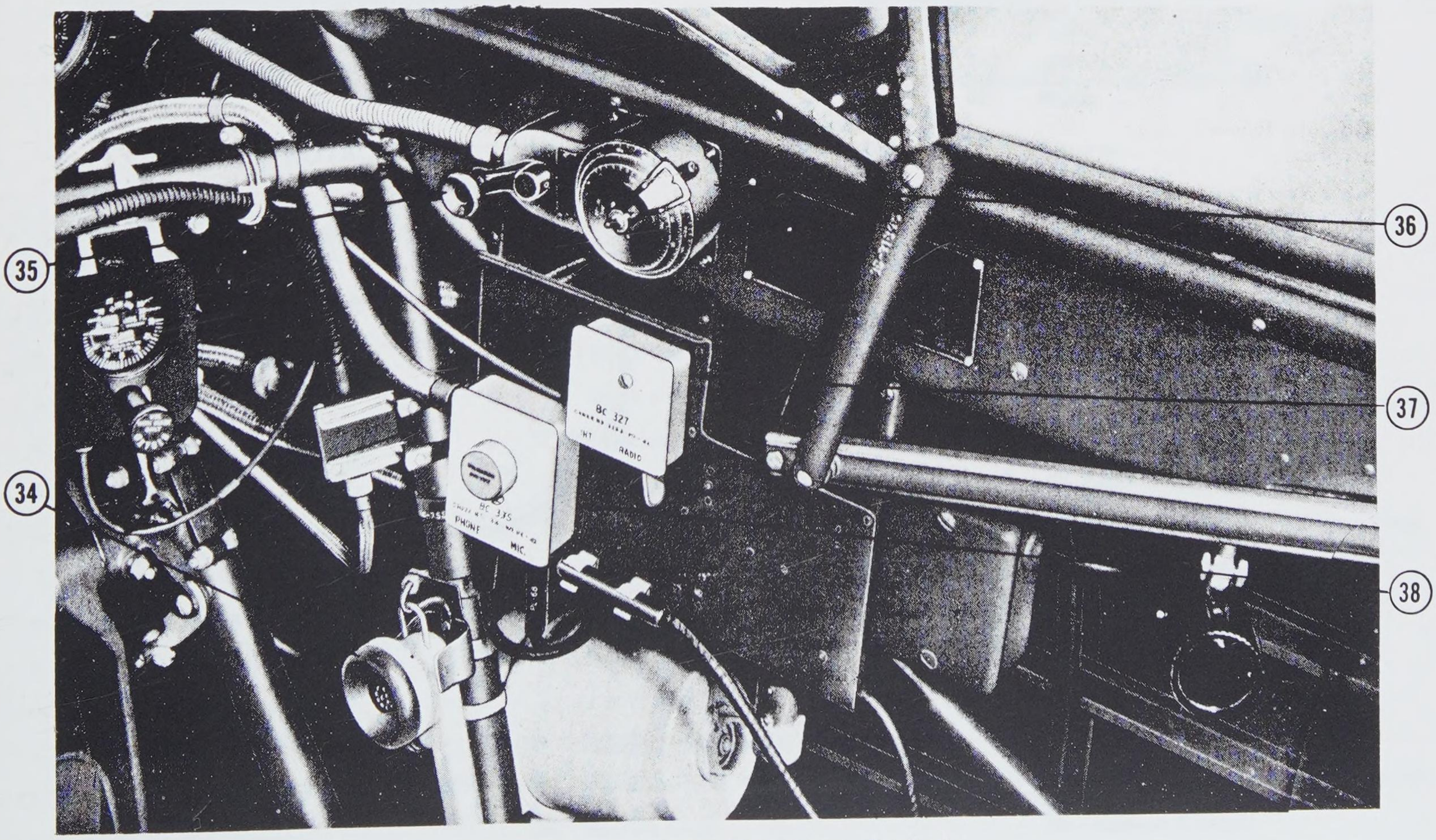
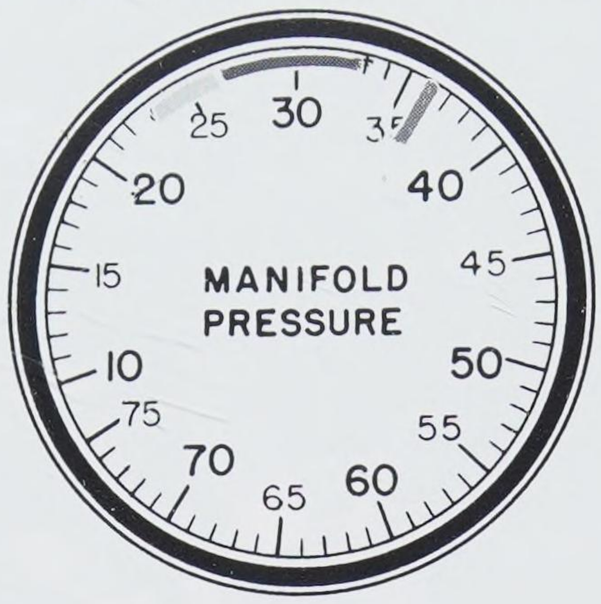


Figure 9 — Right Side Rear Cockpit

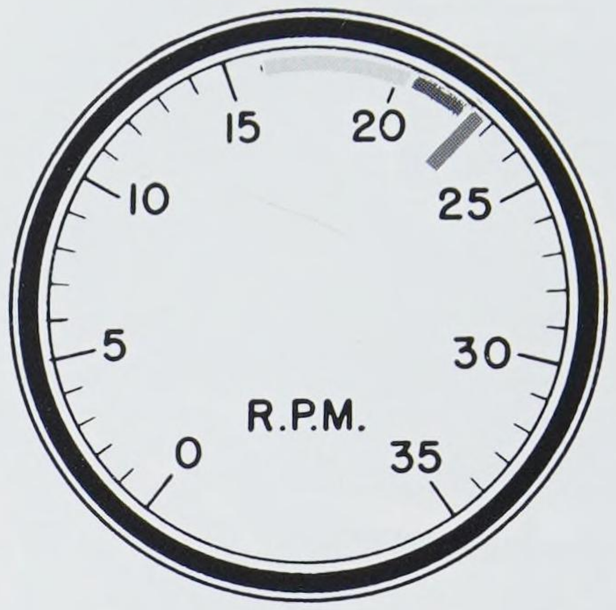
INSTRUMENT MARKINGS

MANIFOLD PRESSURE



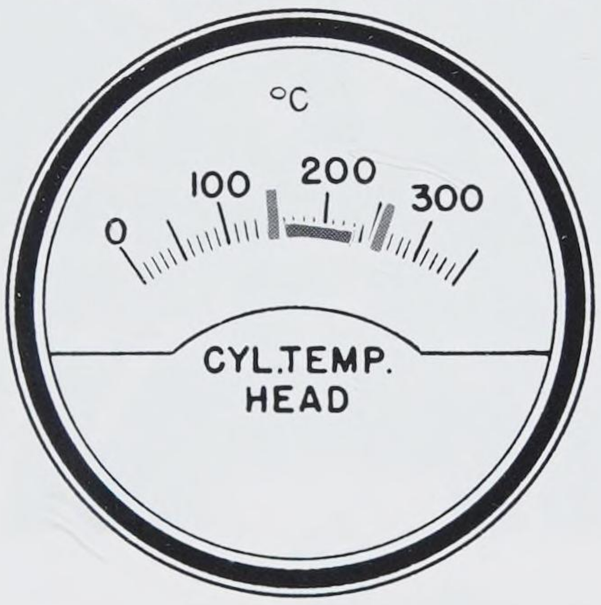
	36
	23 to 26
	26 to 32.5

TACHOMETER



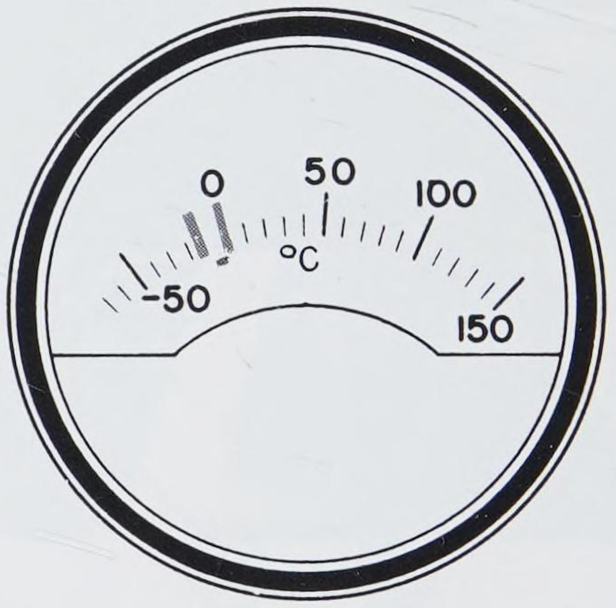
	2250
	1600 to 2000
	2000 to 2200

CYLINDER HEAD TEMP.



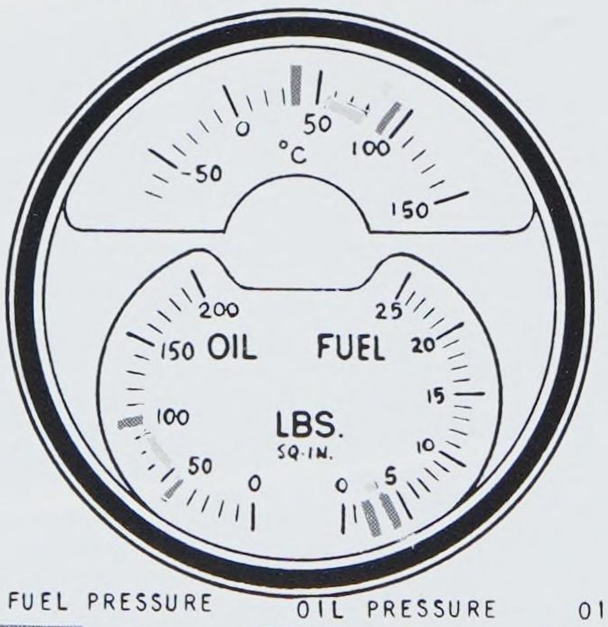
	150
	260
	150 to 232

CARB. MIXT. TEMP.



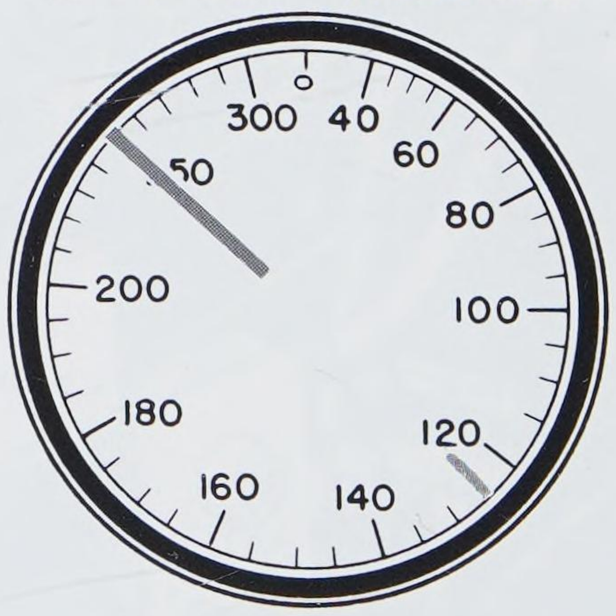
	(-10) & (+3)
	(-10) to (+3)

ENGINE GAGE UNIT



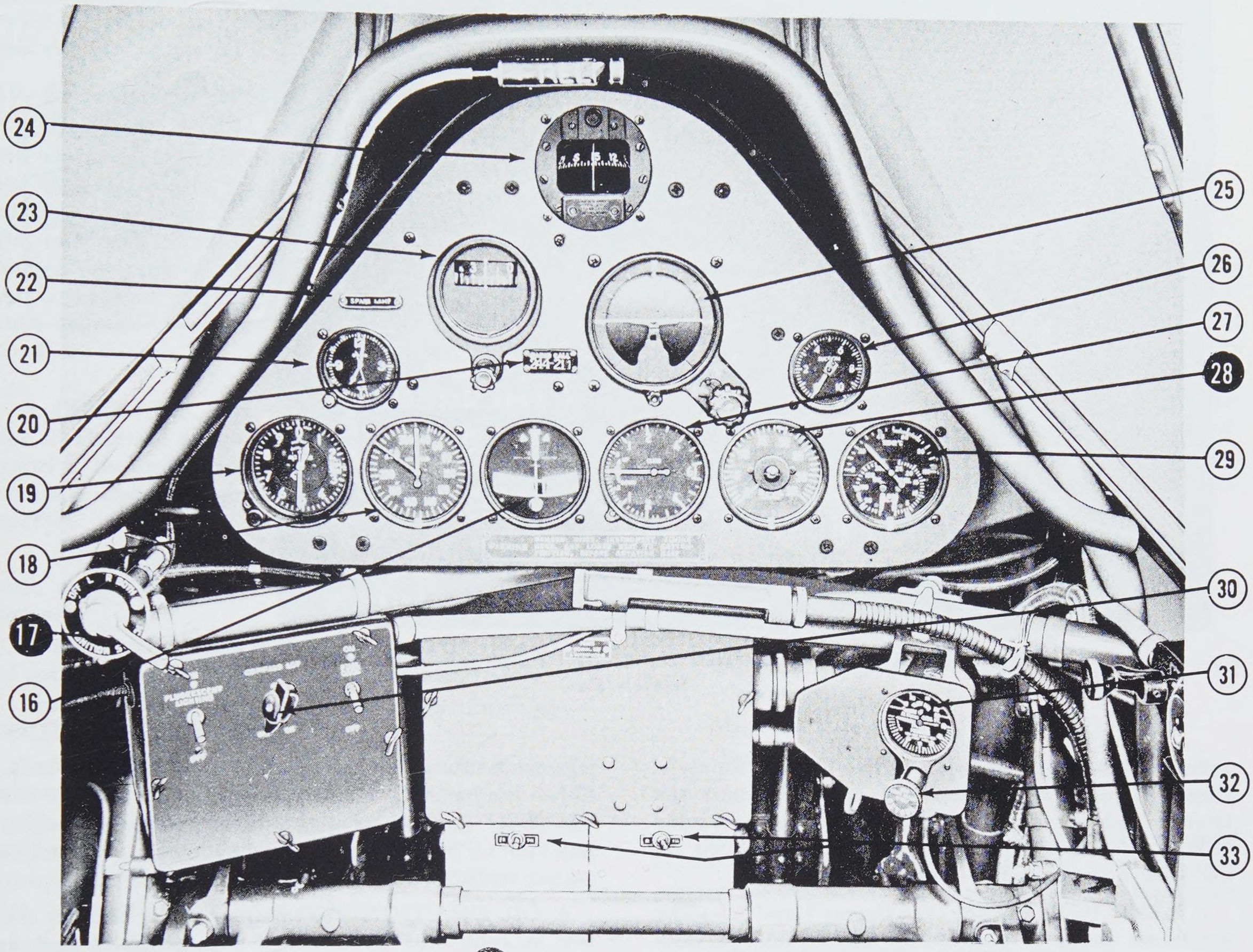
FUEL PRESSURE	OIL PRESSURE	OIL TEMPERATURE
3	50	40
4	100	95
3 to 4	70 to 90	60 to 80

AIR-SPEED INDICATOR



	251
	125 'DO NOT LOWER FLAPS ABOVE THIS SPEED'

	DESIRABLE OPERATING REGION FOR CRUISE
	DESIRABLE OPERATING REGION FROM HIGH CRUISE TO MAX. CONTINUOUS POWER.
	MAX. (LIMIT OR DANGER)
	CAUTIOUS



POWER PLANT CONTROLS

1. Flight Report Case
2. Landing Gear Controls
3. Hydraulic Power Control
4. Elevator Trim Tab Control
5. Flap Control
6. Ventilator Door Handle
7. Rudder Trim Tab Control
8. Fire Extinguisher
9. Engine Control Quadrant
10. Altimeter Correction Chart
11. Blind Flying Hood Release
12. Compass Correction Chart
13. Control Stick (Stowed)
14. Fuel Selector Valve
15. Hand Fuel Pump Handle
16. Bank and Turn Indicator
17. Ignition Switch
18. Air-Speed Indicator
19. Altimeter
20. Radio Call Plate
21. Clock
22. Spare Lamp
23. Directional Gyro
24. Magnetic Compass
25. Gyro Horizon
26. Suction Gage
27. Rate of Climb Indicator
28. Tachometer
29. Oil Temp, Fuel and Oil Pressure Gage
30. Electrical Control Panel
31. Oxygen Pressure and Flow Gage
32. Oxygen Regulator Control
33. Interphone Amplifier Switch
34. Microphone
35. Receiver Tuning Switch
36. Receiver Tuning Dial
37. Radio-Interphone Selector Switch
38. Volume Control

Figure 10 — Center Rear Cockpit

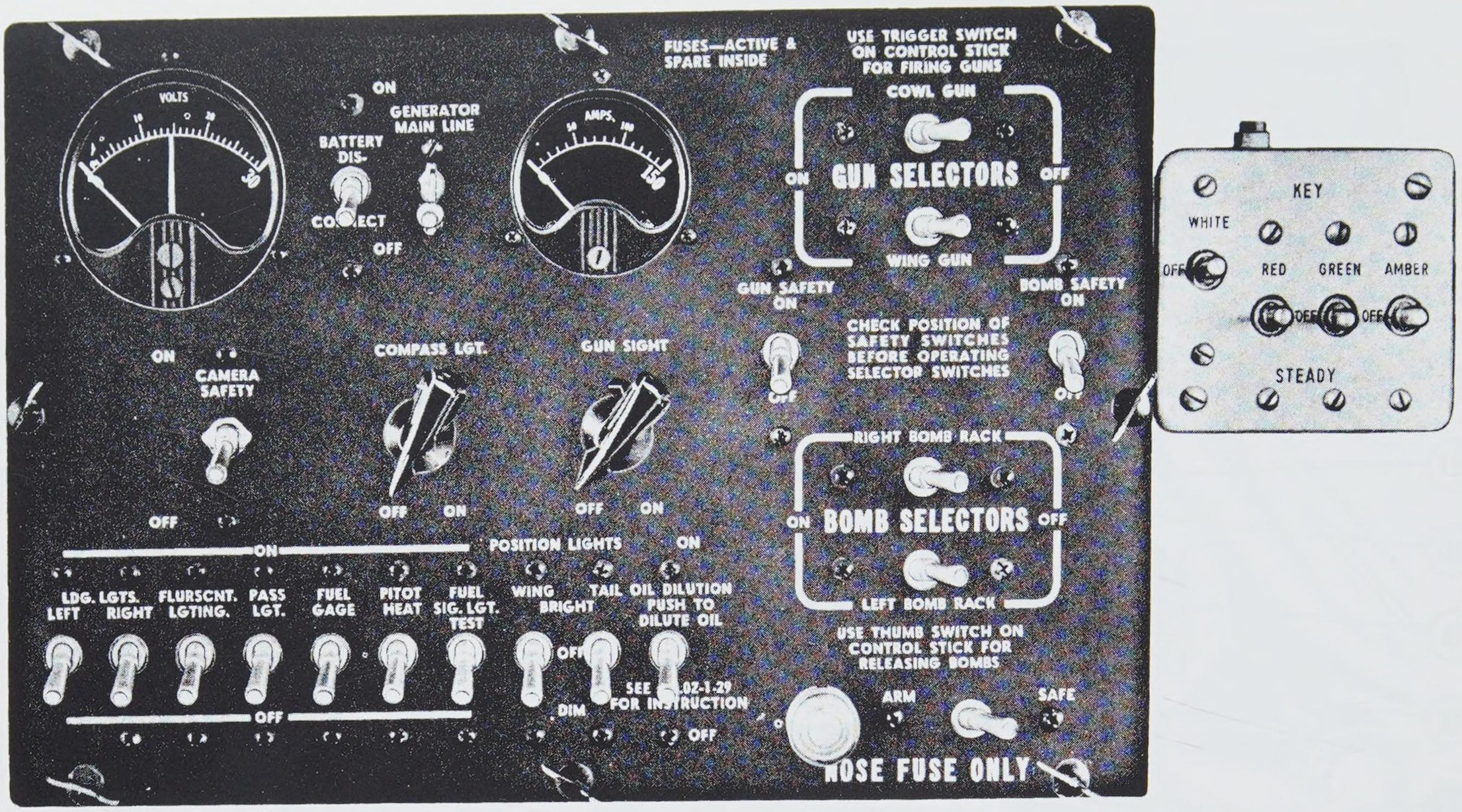


Figure 11 — Front Cockpit Electrical Control Panel and Recognition Light Switch Box

pressure falls below 3 lb/sq in. When the fuel supply is exhausted, the fuel pressure will drop and cause the lamp to light approximately 10 seconds before engine failure. A testing switch for the lamp is located on the front cockpit electrical control panel.

c. HAND FUEL PUMP. *(See figures 5 and 8.)*—The hand fuel pump is operated to obtain fuel pressure when starting the engine, or in case of engine-driven fuel pump failure. An operating handle is located on the control shelf of each cockpit. Insufficient operation of the hand fuel pump will be indicated by the fuel pressure signal lamp.

d. FUEL SELECTOR VALVE. *(See figures 5 and 8.)* —Selection of fuel supply is controlled by a selector valve control located on the control shelf of each cockpit. Fuel flow markings are: "RESERVE", "LEFT", and "RIGHT". An "OFF" position is provided to completely shut off the flow of fuel.

e. FUEL CONTENTS GAGES. *(See figure 19.)*—Two float-type fuel contents gages are located one on either side of the front cockpit seat and are visible from the rear cockpit with approximately 5 gallons parallax error.

9. OIL SYSTEM.

(See figure 4.)

a. GENERAL.—A 10 US (8-1/2 Imperial) gallon oil tank provides the reserve supply for the engine lubricating system. Pressure and temperature indicators are contained in the engine gage units on the two instrument panels. The oil cooler shutter control in the front cockpit is the only manually operated oil system control and is provided for operation in extreme cold weather only. When the handle is in the up position, the shutters are "CLOSED" and when in the down position, the shutters are "OPEN". The control quadrant is notched to permit setting in any intermediate position.

b. OIL DILUTION SYSTEM.—The oil dilution system is controlled by a switch on the front cockpit electrical control panel. With this switch in the "ON"

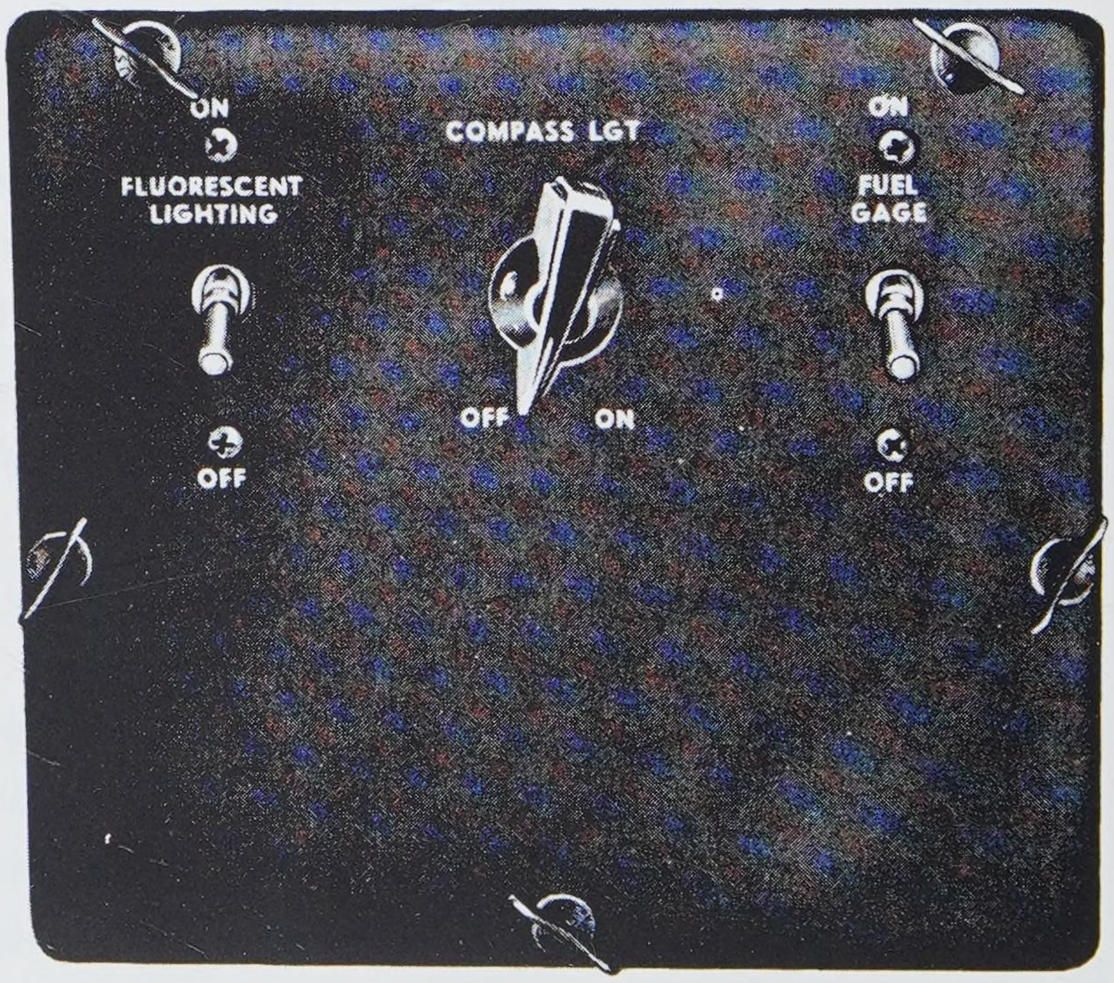


Figure 12 — Rear Cockpit Electrical Control Panel

position, the solenoid valve opens and allows fuel to enter the oil system at the oil "Y" drain valve to lower the viscosity of the oil for cold weather starts.

10. ELECTRICAL SYSTEM.

a. GENERAL.—A twenty-four volt direct current electrical system is installed in this airplane. Power for the electrical system is supplied by a 50-ampere engine-driven generator with a 68-ampere-hour storage battery for reserve. Fluorescent and compass lights requiring alternating current are supplied by a d-c to a-c inverter. All circuits except the bomb release and gun firing circuits are fused in the main fuse box at the left side of the front cockpit.

b. CONTROLS. *(See figures 11 and 12.)*—Controls for all electrical equipment are on the electrical control panel in the front cockpit. Controls for the fluorescent, compass, and fuel gage lights are duplicated in the rear cockpit.

c. LIGHTS.—Two swivel-mounted cockpit lights in each cockpit are controlled by a rheostat on the light housing.

A fluorescent lamp is installed on a flexible cable in each cockpit to illuminate the instrument panel.

Position light switches provide two intensities—"DIM" and "BRIGHT".

Landing lights and the passing light are individually controlled.

The red, green, and amber recognition lights are individually controlled by switches adjacent to the front cockpit electrical control panel. The "WHITE" switch has no function in this installation.

11. INSTRUMENTS.

(See figures 7 and 10.)

a. FLIGHT INSTRUMENTS.

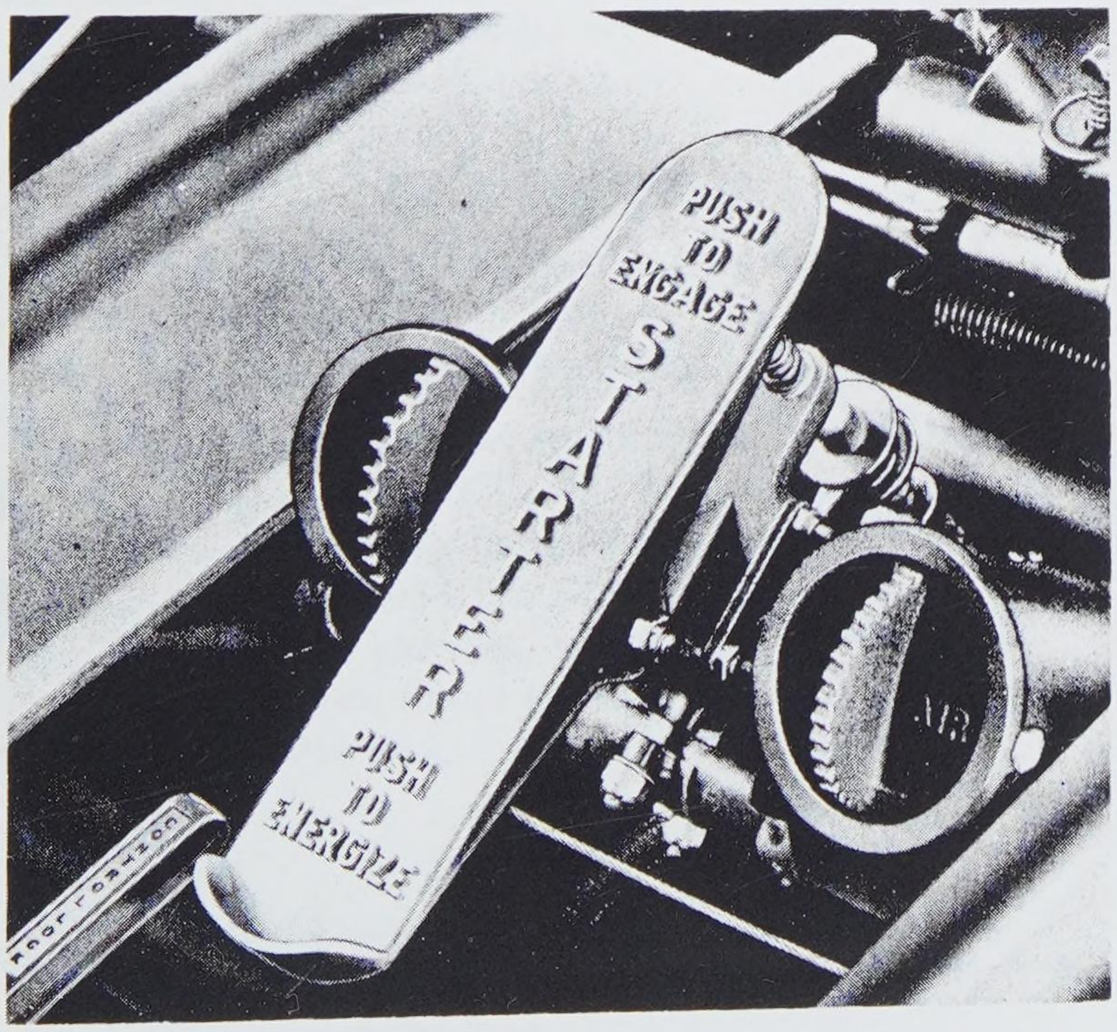


Figure 13 — Starter Switch Pedal

Accelerometer
Air Speed Indicator
Altimeter
Bank and Turn Indicator
Compass, Magnetic
Directional Gyro
Gyro Horizon
Rate of Climb Indicator

These instruments, except the accelerometer which is installed in the front cockpit only, are provided on both instrument panels. The gyro horizon, directional gyro, and bank and turn indicator are gyro instruments run by an engine-driven vacuum pump. The altimeter, rate of climb indicator, and air speed indicator are connected to the pitot head. A pitot head heater switch is located on the front cockpit electrical control panel. Each compass incorporates a lamp controlled by a rheostat located on the respective electrical control panel.

b. ENGINE INSTRUMENTS.

Carburetor Mixture Gage
Cylinder Head Temperature Gage
Engine Gage Unit (fuel and oil pressure, and oil temperature)
Manifold Pressure Gage
Tachometer

These instruments are located on the instrument panel in the front cockpit. The engine gage unit and tachometer are duplicated on the rear cockpit instrument panel.

c. MISCELLANEOUS INSTRUMENTS.

Ammeter
Clock
Free-Air Temperature Indicator
Suction Gage
Voltmeter

The clock and suction gage are installed on both instrument panels. The free-air temperature indicator is installed on the front instrument panel only. The ammeter and voltmeter are located on the front cockpit electrical control panel.

12. HEATING AND VENTILATING SYSTEMS.

Ventilating controls are provided between the rudder pedals in the front cockpit. The volume of hot air taken from the exhaust shroud or cold air from an outside opening is regulated by operating a notched control wheel fitted with a butterfly valve at the outlet of each system. A ventilator door is located at the left rear side of the rear cockpit. A handle located directly beneath the fire extinguisher controls the flow of air.

Airplanes allocated to the United Kingdom contain

a special heating system to heat both cockpits and the wing gun and to defrost the windshield. A control valve is operated by a handle located on the right side of the front cockpit.

13. MISCELLANEOUS EQUIPMENT.

a. PILOT'S RELIEF TUBE.—A relief tube horn is attached by a bracket to the bottom of each seat.

b. ENGINE CRANK. —An engine crank is stowed at the rear of the baggage compartment.

c. INSTRUMENT FLYING HOOD. *(See figure 29.)* —Provisions are included in each cockpit for the installation and operation of an instrument flying hood.

d. DATA AND MAP CASES.—A flight report case is provided at the left side of each cockpit seat and a map and data case is mounted below the radio equipment in the front cockpit.

SECTION II
NORMAL OPERATING INSTRUCTIONS

1. BEFORE ENTERING THE PILOT'S COCKPIT.

a. FLIGHT LIMITATIONS AND RESTRICTIONS.

(1) MANEUVERS PROHIBITED.

Outside loop
Inverted flight in excess of 10 seconds
Snap rolls in excess of 130 MPH IAS
Slow rolls in excess of 190 MPH IAS
Spins and stalls when normal gross weight is exceeded

WARNING

Solo flights should never be made in the rear cockpit.

(2) AIR SPEED LIMITATIONS.

Maximum permissible diving speed is 240 MPH IAS.
With wing flaps set at 45 degrees, do not exceed 125 MPH IAS.
In a sideslip, stay above 90 MPH IAS
Do not lower landing gear above 150 MPH IAS.

Note

These limitations may be supplemented or superseded by instructions included in Service publications.

b. DATA CHECK.

(1) Make sure the airplane has been serviced and is ready for flight. Check Form 1.

(2) Check Weight and Balance Charts in the data case to ascertain that the load and balance requirements of the airplane are satisfied.

c. ENTRY.—To gain entrance to either cockpit, lift the latch and push the sliding enclosure.

2. ON ENTERING THE PILOT'S COCKPIT.

a. STANDARD CHECK FOR ALL FLIGHTS.

(1) Adjust rudder pedals for proper leg length to obtain full brake control while taxying. *(See figure 15.)*

(2) Adjust the seat level to obtain full rudder travel. *(See figure 16.)*

(3) See that ignition switch *(33 figure 7)* is "OFF"

(4) Set parking brakes *(61 figure 7)*.

(5) Check that all armament switches are "OFF" *(See figure 11.)*

Figure 14 - Instrument Marking - Replaced by Chart on Page 24A.

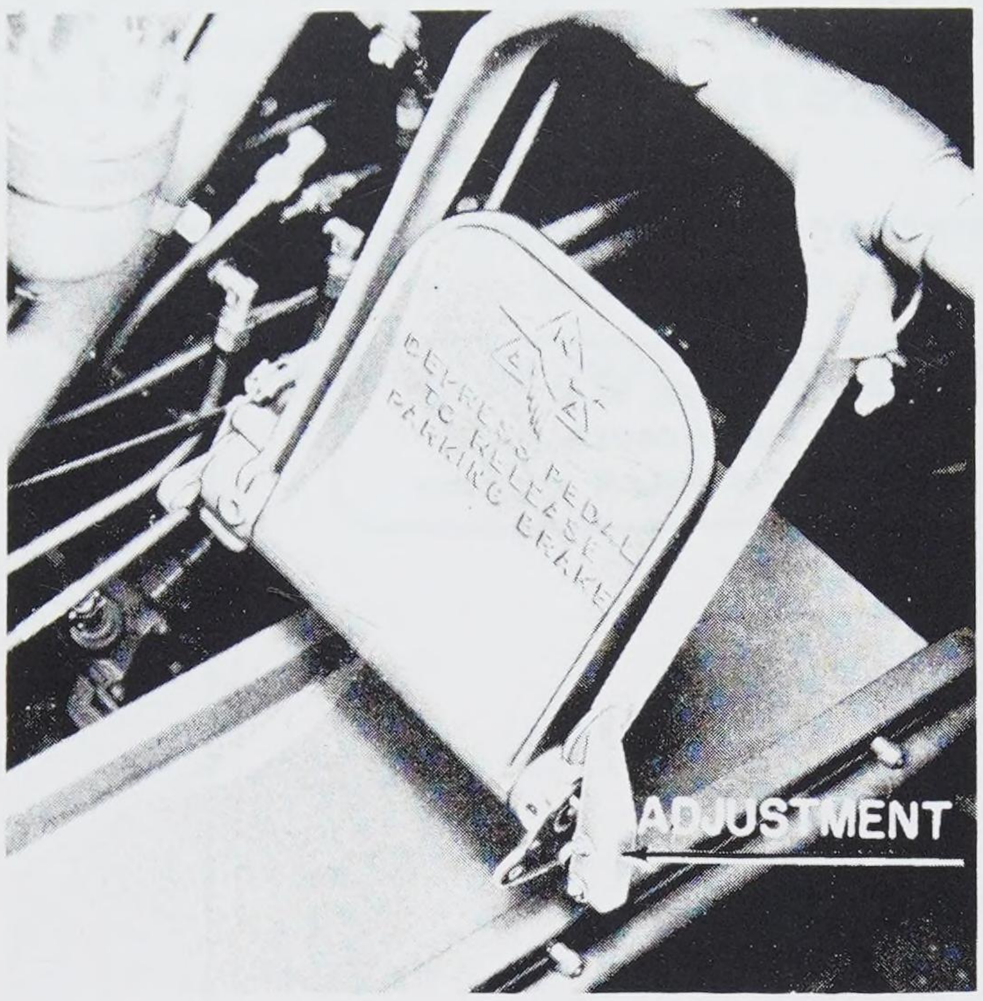


Figure 15—Rudder Pedal and Adjustment

(6) See that landing gear control handle *(4 figure 5)* is in the "DOWN" position.

(7) Unlock the surface control lock. *(See figure 17.)*

(8) Set altimeter *(36 figure 7)* to correct barometric pressure.

(9) Place battery-disconnect switch in "ON" position. *(See figure 11.)*

(10) Check gun sight illumination by placing "GUN SIGHT" rheostat in "ON" position. *(See figure 11.)*

(11) Check pitot head heater by placing "PITOT HEAT" switch in "ON" position momentarily. *(See figure 11.)*

CAUTION

If pitot head heater is left on for relatively long periods on the ground, the element may be damaged or burned out.

(12) If use of interphone equipment is desired, check the system for proper functioning. For operating instructions, see section V.

(13) Check fuel pressure warning light by operating test switch. *(See figure 11.)*

(14) If oxygen is to be used, check for satisfactory operation. Check gage for pressure above 1800 lb/sq in.

b. SPECIAL CHECK FOR NIGHT FLIGHTS.—*(See figure 11.)*

(1) Turn "ON" desired cockpit and instrument lights.

(2) Turn "ON" the fuel gage lights.

(3) Turn "ON" compass lights.

(4) Turn position lights to "DIM" and "BRIGHT".

(5) Check operation of landing lights and passing light.

(6) Check operation of recognition lights.

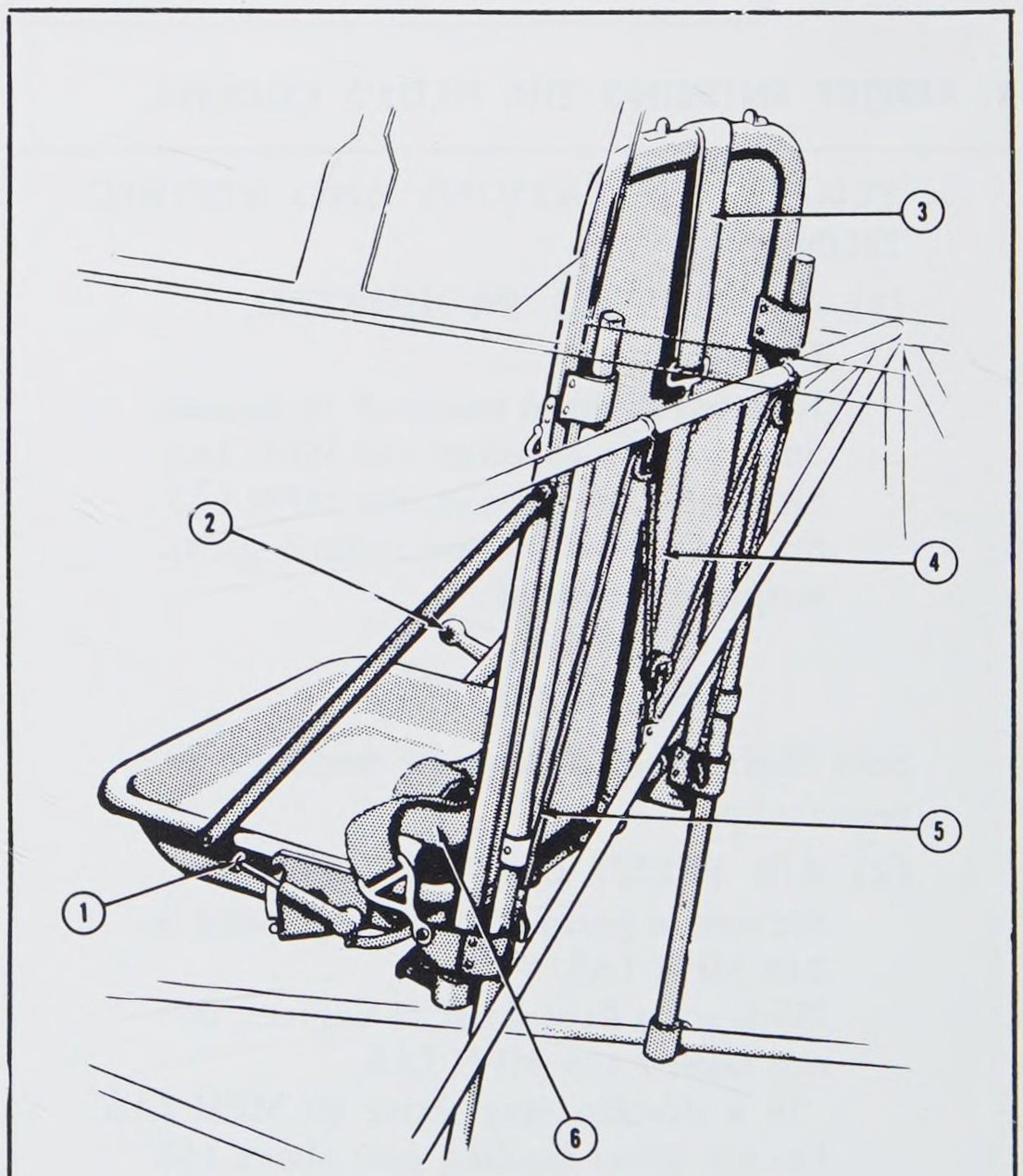
CAUTION

Do not operate recognition, passing, or landing lights for more than 10 seconds when the airplane is on the ground, as there must be air circulation to dissipate the heat from the light.

3. FUEL AND OIL SYSTEM MANAGEMENT.

a. Check fuel selector valve *(6 figure 5)* operation before take-off. The following fuel selector valve positions are recommended:

Start	"RESERVE"
Warm-up	Check all tanks
Taxying and take-off	"RESERVE"
Cruise	"LEFT" and "RIGHT" to maintain trim
Acrobatics	"RESERVE"
Landing	"RESERVE"



1. Shoulder Harness Operating Lever
2. Elevation Lock Handle
3. Shoulder Harness
4. Shoulder Harness Take-Up Mechanism
5. Shock Cord
6. Safety Belt

Figure 16—Pilot Seat

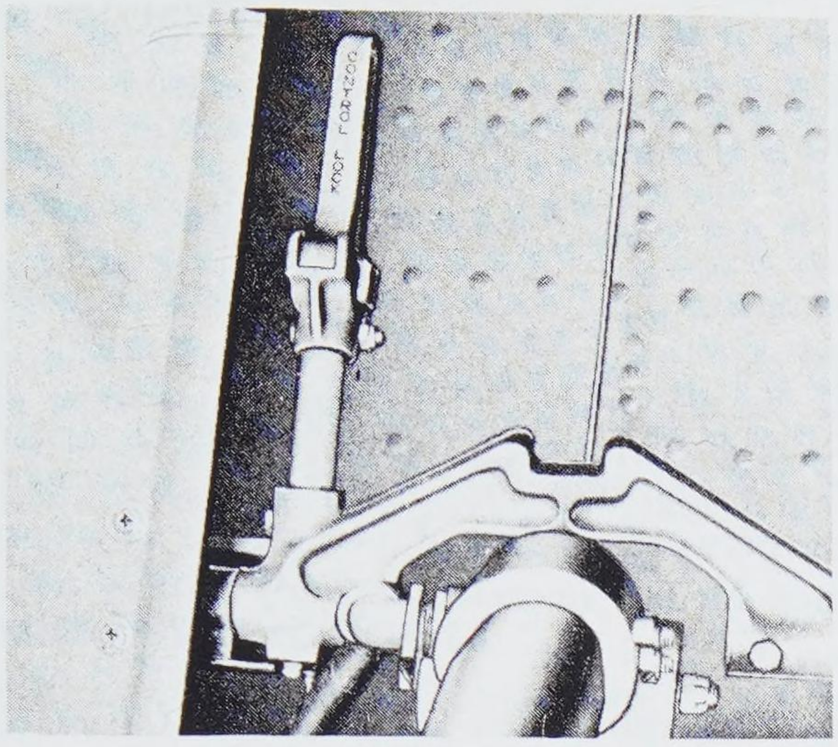


Figure 17 — Surface Control Lock

b. Oil dilution is accomplished in the following manner:

(1) Operate the engine at 1000 to 1200 rpm.

(2) Maintain oil temperature from 5° to 50°C and oil pressure above 15 lb/sq in.

(3) Dilute engine oil as follows for ground temperatures shown: (The oil dilution switch must be held "ON".) *(See figure 11.)*

4° to −12°C (40° to +10°F) 3 minutes
−12° to −29°C (10° to −20°F) 6 minutes
−29° to −46°C (−20° to −50°F) 9 minutes
Add 1 minute of dilution for each additional 5°C (9°F) below −46°C.

(4) During the last minute of dilution, increase rpm to 1500 and slowly move the throttle *(1 figure 21)* to give 26 in. Hg and then back to the original position.

4. STARTING ENGINE.

a. Head the airplane into the wind and set the parking brakes.

b. If flying solo, make certain that the rear cockpit stick is locked in the *stowed* position. See that there is no equipment in the rear cockpit that might foul the controls.

c. Visually check that fire guard is posted.

d. See that ignition switch is "OFF".

e. Have ground personnel turn propeller 6 blades by hand.

f. Open throttle *(1 figure 21)* approximately ½ inch (600-800 rpm).

g. Move mixture control *(3 figure 21)* to full "RICH".

h. Propeller control *(5 figure 21)* in full "DECREASE RPM".

i. Place carburetor heat control *(7 figure 5)* to full *"COLD"*.

j. Ascertain that the oil cooler shutters *(60 figure 7)* are "OPEN".

k. Turn fuel selector to "RESERVE". *(See figure 18.)*

l. Turn battery and generator main line switches "ON". *(See figure 11.)*

CAUTION

Use hand crank for all cold weather starts.

m. Turn ignition switch *(33 figure 7)* to "BOTH".

n. Prime engine four to six strokes when cold, two to four strokes when warm, and none when hot. *(See 57 figure 7.)*

o. Check to see that propeller is clear.

WARNING

Use of hand fuel pump may flood carburetor with subsequent fire hazard.

q. Press heel of starter pedal. *(See figure 13.)* When the flywheel has reached maximum rpm, engage the starter with the engine by pressing the toe of the starter pedal. As the engine starts, release pressure on the pedal.

WARNING

If a fire develops due to backfiring, it can be extinguished by immediately re-energizing and re-engaging the starter.

r. After the engine has fired, manipulate the throttle to obtain 500 to 600 rpm as quickly as possible.

s. Check the oil pressure. If oil pressure gage registers no pressure after 30 seconds, stop the engine and investigate.

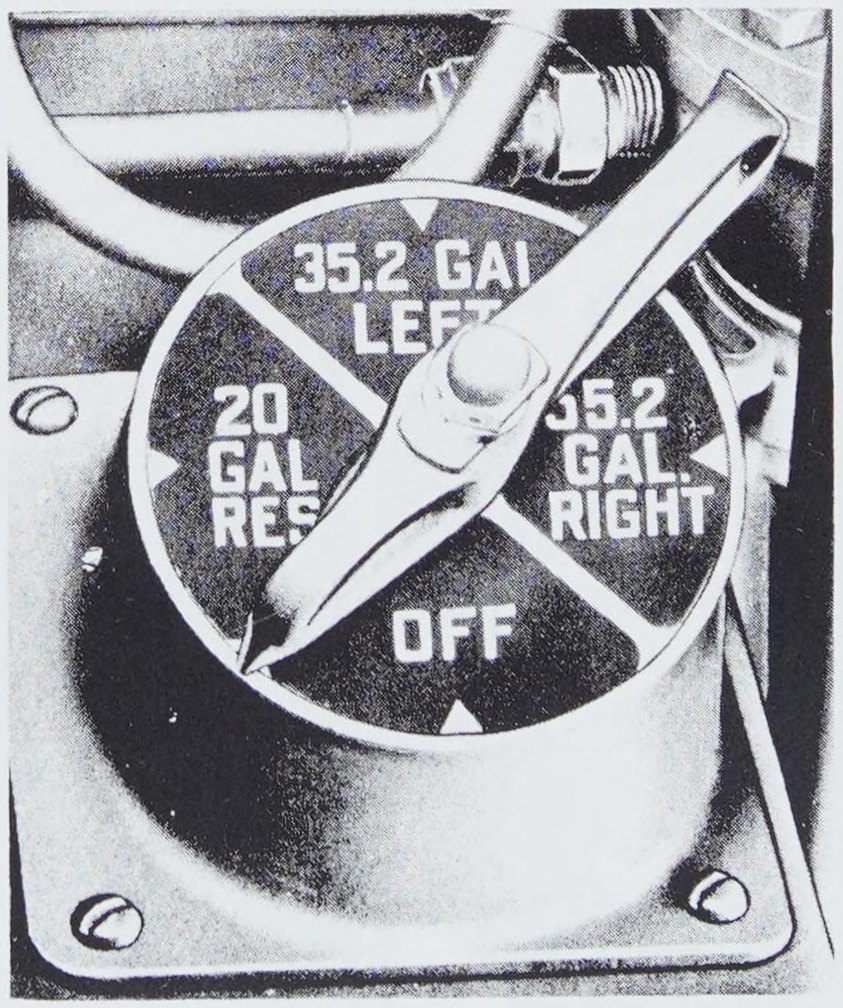


Figure 18 — Fuel Selector Control

5. WARM-UP AND GROUND TEST.

a. When oil pressure reaches 70 to 90 lb/sq in., open the throttle *(1 figure 21)* to obtain approximately 1000 rpm.

b. Set propeller control at full "INCREASE RPM".

c. Check instruments for the following limitations:

	DESIRED	MINIMUM	MAXIMUM
Oil Pressure	70-90	50	100
Oil Temperature	60°C to 80°C	40°C	95°C
Fuel Pressure	3-4	3	4

d. Check reserve, left, and right fuel systems by rotating fuel selector *(6 figure 5)*.

e. Open manifold pressure gage drain *(12 figure 5)* momentarily.

f. With Propeller control in full "INCREASE RPM", move the throttle forward to obtain 2200 rpm and accomplish a single ignition check with a maximum allowable drop of 75 rpm. Tachometer and manifold pressure readings must be allowed to stabilize after switching to one magneto. Operation on single ignition for a period as long as one minute is permissible, but should not be exceeded. The ignition switch will be returned to "BOTH" position prior to checking the other magneto.

g. At 700 rpm, check "OFF" position of ignition switch.

h. At 1000 rpm, check the following:

Suction	3.75 to 4.25 in. Hg
Hydraulic Pressure	800 to 1000 lb/sq in. (power control lever engaged)
Ammeter	50 amps maximum

i. Check to determine that generator cuts in for charging between 1000 and 1200 rpm by checking voltmeter and ammeter. *(See figure 11.)* Voltmeter should register between 14.25 and 14.5 volts. Charging rate as indicated by the ammeter depends on the condition of the battery.

j. At 1600 rpm, move propeller control *(5 figure 21)* back to note 200 rpm drop (maximum); then move forward to full "INCREASE RPM".

k. Check operation of wing flaps with hand pump *(5 figure 5)* and engine-driven hydraulic pump.

CAUTION

Avoid prolonged operation above 1400 rpm. Do not exceed 232°C (450°F) cylinder head temperature during ground operations.

l. Check flying controls for free movement. Look at control surfaces.

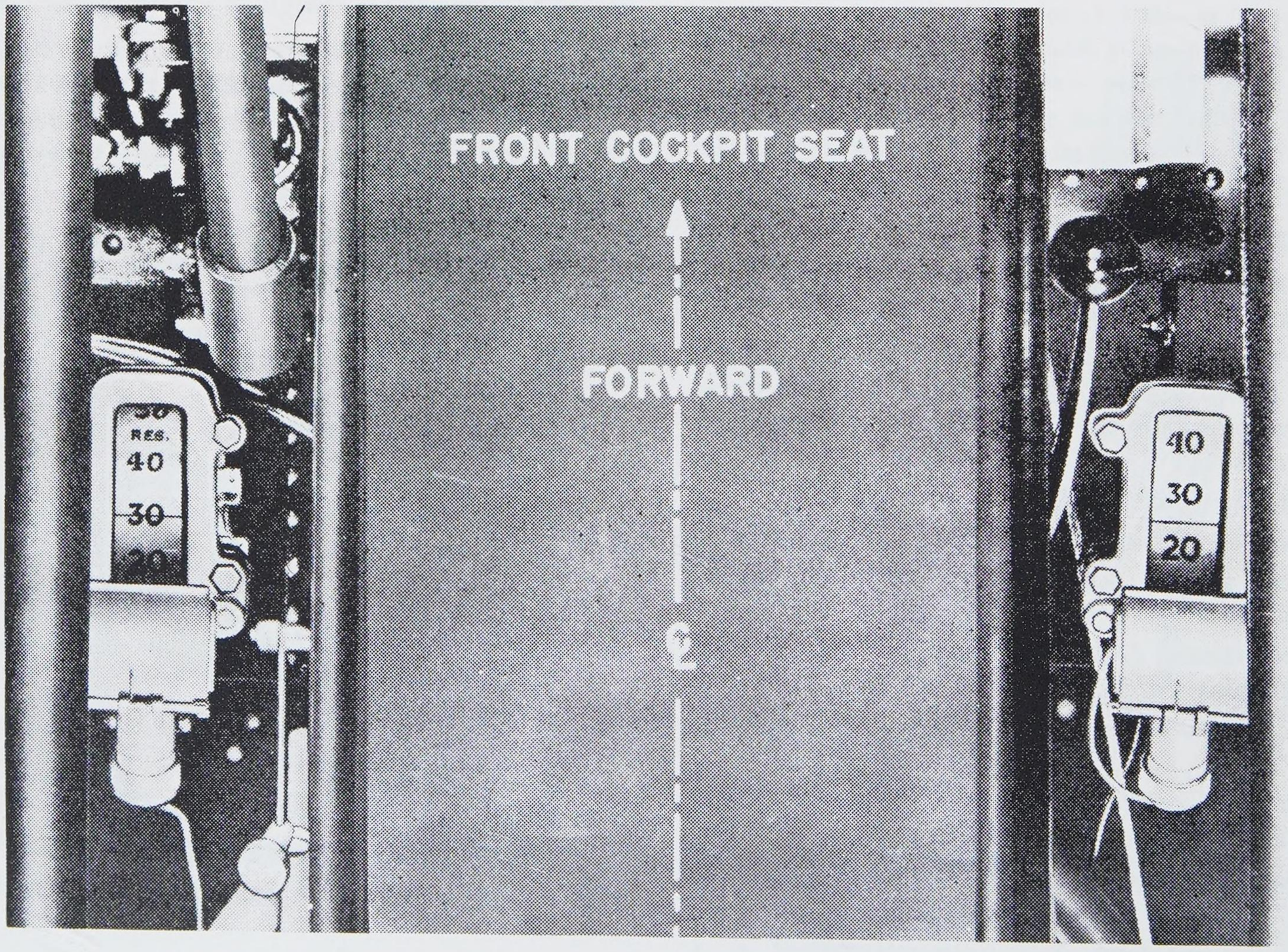


Figure 19 — Fuel Contents Gages

m. Set the elevator and rudder trim tabs *(8 and 9 figure 5)* at "NEUTRAL."

n. Check communication equipment for proper operation. (See section V, paragraph 1.)

o. Release parking brakes.

6. SCRAMBLE TAKE-OFF.

Use oil dilution (2 minutes maximum) to obtain proper oil pressure at moderate power. Check for a rise in oil temperature, and as soon as the engine will *take* the throttle, release the parking brakes, taxi out, and take off.

7. TAXYING INSTRUCTIONS.

a. Steer a zigzag course to obtain an unobstructed view.

b. Use the brakes as little as possible and always taxi cautiously.

c. Upon reaching the take-off position, stop the airplane cross-wind so approaching airplane may be seen plainly.

d. If take-off is delayed, clear the engine by opening the throttle against the brakes to about 25 in. Hg manifold pressure (1900 rpm).

8. TAKE-OFF.

a. When take-off area is clear, quickly check the following:

(1) Generator main line switch "ON"

(2) Mixture control full "RICH"

(3) Fuel selector on "RESERVE" (Check fuel levels.)

(4) Fuel pressure 3 to 4 lb/sq in.

(5) Propeller control full "INCREASE RPM"

(6) Carburetor air control in full "COLD"

(7) Wing flaps "UP" (If high obstacles are to be cleared and only a short run is available, place flaps in 15 degrees down.)

(8) Gyro instruments uncaged

Note

Gyro instruments should be left uncaged at all times except during acrobatics. When the rear cockpit is unoccupied, cage the rear gyro instruments before take-off.

(9) Oil pressure 70 to 90 lb/sq in.

(10) Oil temperature 50° to 70°C.

(11) Cylinder head temperature 150°C minimum for take-off.

b. Adjust throttle friction sufficiently to prevent creepage if hand is removed.

c. Check lap belt, tighten and lock shoulder harness.

d. Turn into the wind and lock the tail wheel.

e. Open throttle gradually to 36 in. Hg and take off at 2250 rpm (maximum cylinder head temperature 260°C for 5 minutes).

f. Do not attempt to lift the tail too soon, as this increases the torque action. Maintain a constant attitude until sufficient speed is attained, then raise the tail slowly.

9. ENGINE FAILURE DURING TAKE-OFF.

a. To reduce the possibility of and danger from engine failure during take-off, observe the following practices:

(1) Run up engine carefully and check thoroughly before take-off.

(2) Retract the landing gear as soon as the airplane is definitely air-borne.

(3) If flaps are used, raise as soon as the airplane reaches a safe altitude.

b. If the engine fails immediately after take-off:

(1) Depress the nose at once so that the air speed does not drop below stalling speed.

(2) If bombs are installed, salvo them immediately.

(3) Open the sliding enclosure.

(4) If the landing gear has started to come up, *do not try to lower it.*

(5) Lower the flaps fully if possible.

(6) Turn "OFF" ignition switch and battery disconnect switch.

(7) Turn fuel selector valve "OFF."

(8) Land straight ahead, changing direction only to miss obstructions.

10. CLIMB.

As soon as the airplane is sufficiently clear of the ground, proceed as follows:

a. Push the hydraulic power control lever *(1 figure 5).*

b. Retract the landing gear. Pull the landing gear control *(4 figure 5)* to the "UP" position and leave it up.

c. Ease back on the throttle to 32.5 in. Hg and propeller control to about 2200 rpm. Climb at 115 MPH IAS.

d. Raise the flaps if used. Pull the flap control *(2 figure 5)* to the "UP" position and leave it up.

CAUTION

Always reduce manifold pressure first, then rpm. Move throttle and propeller controls slowly.

e. Check the cylinder head and oil temperatures and the oil pressure.

f. Turn the fuel selector from "RESERVE" to "LEFT". *(See figure 18.)*

g. Adjust the trim tabs *(8 and 9 figure 5)* so that airplanes flies *hands off.*

h. Refer to "Take-Off, Climb, and Landing Chart", appendix I, for rates of climb applicable.

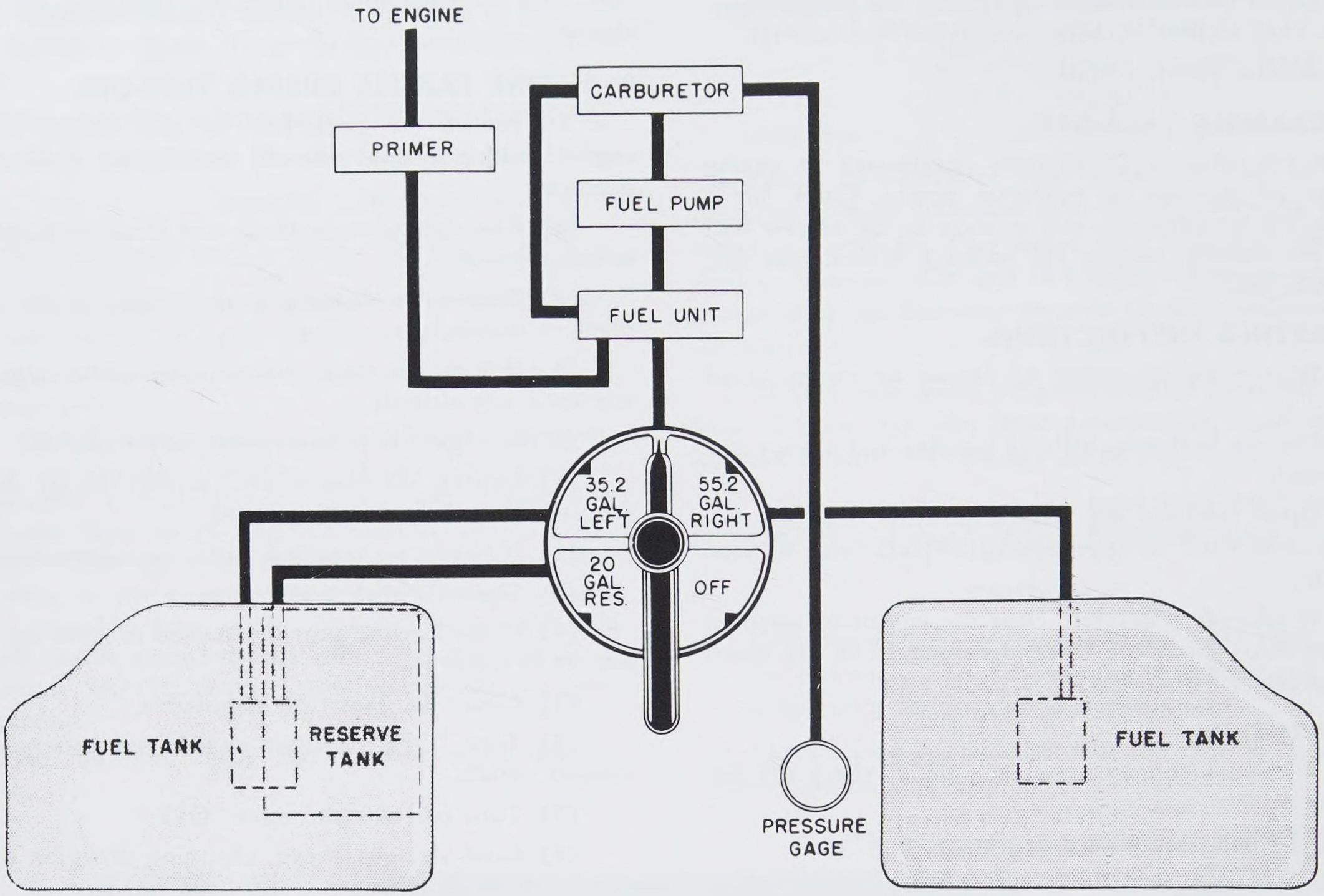


Figure 20 — Fuel Flow Diagram

11. GENERAL FLYING CHARACTERISTICS.

a. The lowest fuel consumption is obtained by using a lean mixture and throttling down the engine to the lowest speed at which the airplane will fly satisfactorily and the engine will run smoothly. This speed is 130 mph at 1600 rpm and 24 in. Hg, the propeller in "DECREASE RPM", at approximately 1000 feet altitude.

b. Although less economical, the desired cruising conditions are 1850 rpm, 26 in. Hg, and 155 mph at 5,000 feet altitude. Do not lean the mixture too much, as serious damage may result from overheated cylinders.

c. For engine operation, refer to "Power Plant Chart", section III, and "Flight Operation Instruction Charts", appendix I.

d. The effect of flap and landing gear operation on the trim of the airplane in flight is as follows:

Landing gear retracted	no effect
Landing gear extended	no effect
Flaps lowered	nose heavy
Flaps raised	tail heavy
Flaps raised from full down at 80 MPH IAS	airplane sinks approximately 20 feet
Flaps raised from full down at 75 MPH IAS	airplane sinks approximately 40 feet

e. Air speed must not fall below 90 MPH IAS while sideslipping. Recovery from a sideslip should be effected above 200 feet.

f. Surface controls, particularly the rudder, are slightly less responsive with the flaps down; therefore turns and sideslips with the flaps fully lowered must not be made with less than 400 feet altitude.

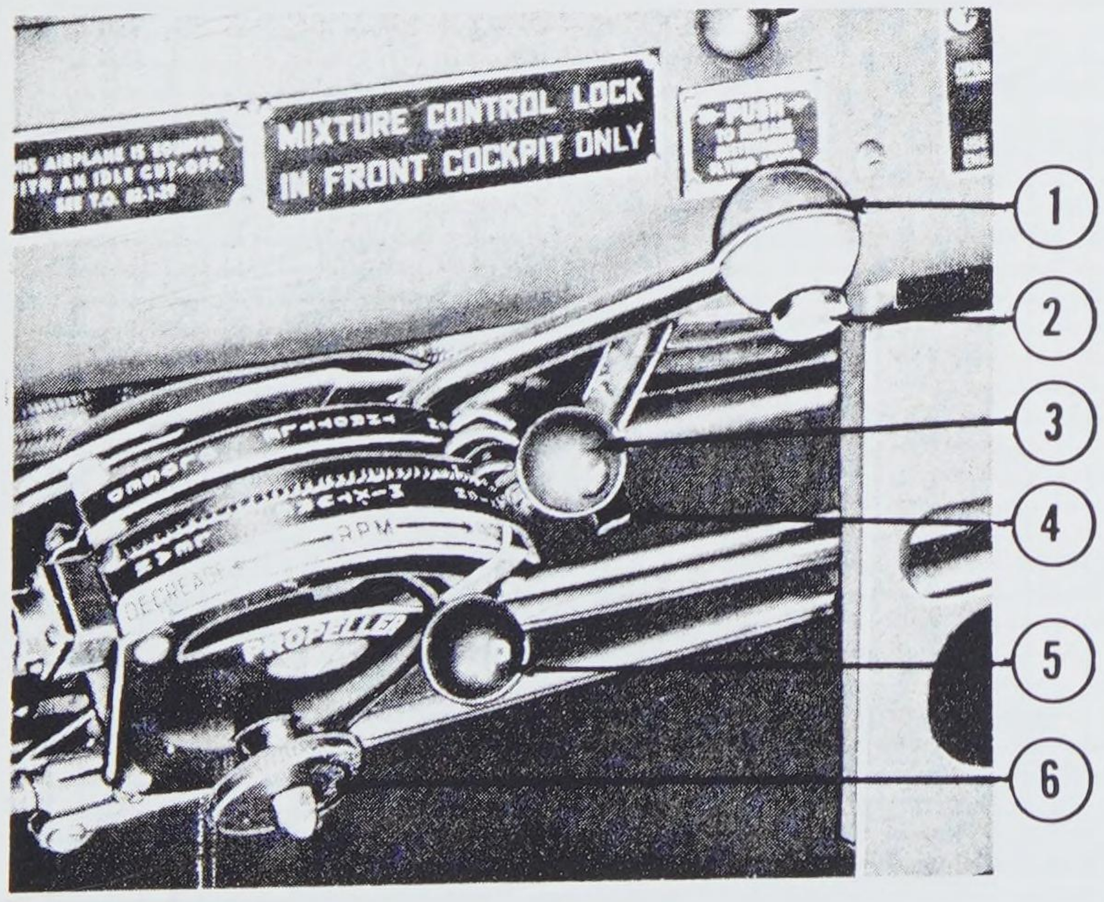
g. Runaway propeller caused by excess power and decreased load on the engine, present in a prolonged steep dive, should be corrected by reducing the throttle setting and returning the airplane to normal flight attitude. During such dives, keep manifold pressure above 15 in. Hg, pay careful attention to tachometer readings, and reduce the throttle as necessary to prevent increased engine speed. A quick increase in throttle setting after the throttle has been retarded, with propeller control set for 1900 rpm, can also cause a runaway propeller. This change in rpm usually occurs at the critical period following take-off or in approach for landing when the throttle is momentarily decreased to check operation of the landing gear warning horn, at which time little excess altitude is available for emergencies. This rapid increase may cause the engine to overspeed which destroys the sensitive balance of constant speed control. To remedy, immediately put an increased load upon the

ting and returning the airplane to normal flight attitude. During such dives, keep manifold pressure above 15 in. Hg, pay careful attention to tachometer readings, and reduce the throttle as necessary to prevent increased engine speed. A quick increase in throttle setting after the throttle has been retarded, with propeller control set for 1900 rpm, can also cause a runaway propeller. This change in rpm usually occurs at the critical period following take-off or in approach for landing when the throttle is momentarily decreased to check operation of the landing gear warning horn, at which time little excess altitude is available for emergencies. This rapid increase may cause the engine to overspeed which destroys the sensitive balance of constant speed control. To remedy, immediately put an increased load upon the engine and propeller by putting the airplane in a climbing attitude, if possible, and slowly retard the throttle setting until the rpm again comes under control.

b. Gliding may be carried out at any safe speed down to the recommended margin of about 25 percent above stalling speed. With the landing gear and flaps up the glide is very flat, and at the best gliding speed of about 100 MPH IAS, long distances can be covered for a comparatively small loss of altitude. Lowering either flaps or landing gear greatly steepens the gliding angle and increases the rate of descent.

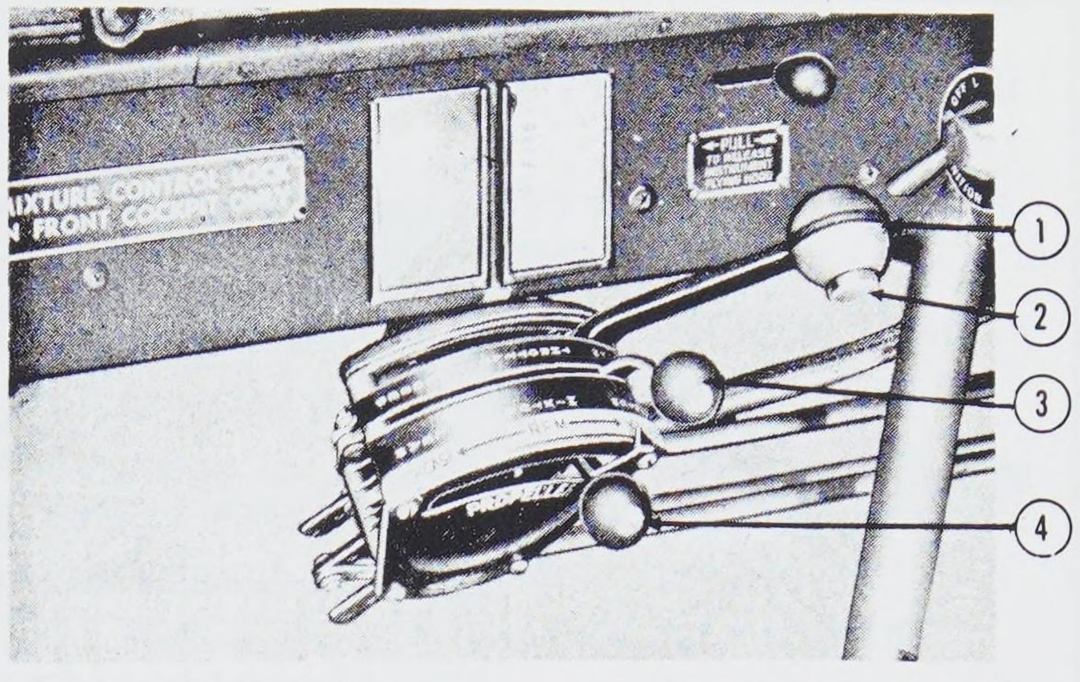
GLIDING SPEED CHART

IAS (MPH)	GLIDING ANGLE	L. G. and FLAPS	POWER
100	Best	"UP"	"OFF"
95	Best	"DOWN"	"OFF"
90	Steep	"DOWN"	"OFF"
85	Best	"DOWN"	"ON"
80	Steep	"DOWN"	"ON"



1. Throttle Control
2. Throat Microphone Switch
3. Mixture Control
4. Mixture Control Lock Release
5. Propeller Control
6. Friction Lock

Figure 21 — Engine Control Quadrant — Front Cockpit



1. Throttle Control
2. Throat Microphone Switch
3. Mixture Control
4. Propeller Control

Figure 22 — Engine Control Quadrant — Rear Cockpit

12. STALLS.

STALLING SPEED CHART

GROSS WEIGHT	GEAR AND FLAPS UP	GEAR AND FLAPS DOWN
5300 Pounds	72 mph (IAS)	64 mph (IAS)
6000 Pounds	77 mph (IAS)	69 mph (IAS)

a. When the stalling incidence is reached with landing gear and flaps up, a wing will drop. If the backward movement on the stick continues when the wing drops, the airplane will fall into a steep spiral. The stalling incidence is reached with the control stick only a short distance back when the airplane nears stalling speed, because of sensitive elevators.

b. Decrease the whip when stalling by putting the stick forward at the start and applying opposite rudder. If putting the stick forward is delayed until the airplane is on its back, an inverted spin may result.

c. No warning of a stall should be relied on, although buffeting and pitching usually precede a stall.

d. During a practice stall, do not pull the nose up in order to stall; instead, counteract its tendency to sink by easing back the stick. When a wing drops, put the stick forward at once and apply opposite rudder.

e. With flaps and landing gear down, stalling incidence is reached about 64 **mph** IAS. As speed is reduced, the right wing drops quickly and; unless recovery is effected immediately, the airplane may whip into a half roll and attempt to spin.

13. SPINS.

Spins should not be made intentionally with flaps and landing gear down. Should an inadvertant spin occur, recovery can be effected after 1-1/2 or 2 turns by first applying full opposite rudder and then pushing the control stick forward to neutral. The ailerons are held in the neutral position. Centralize the rudder as soon as the airplane is in a straight dive to prevent a spin in the opposite direction. Bring the airplane out of the dive and return the control stick to neutral.

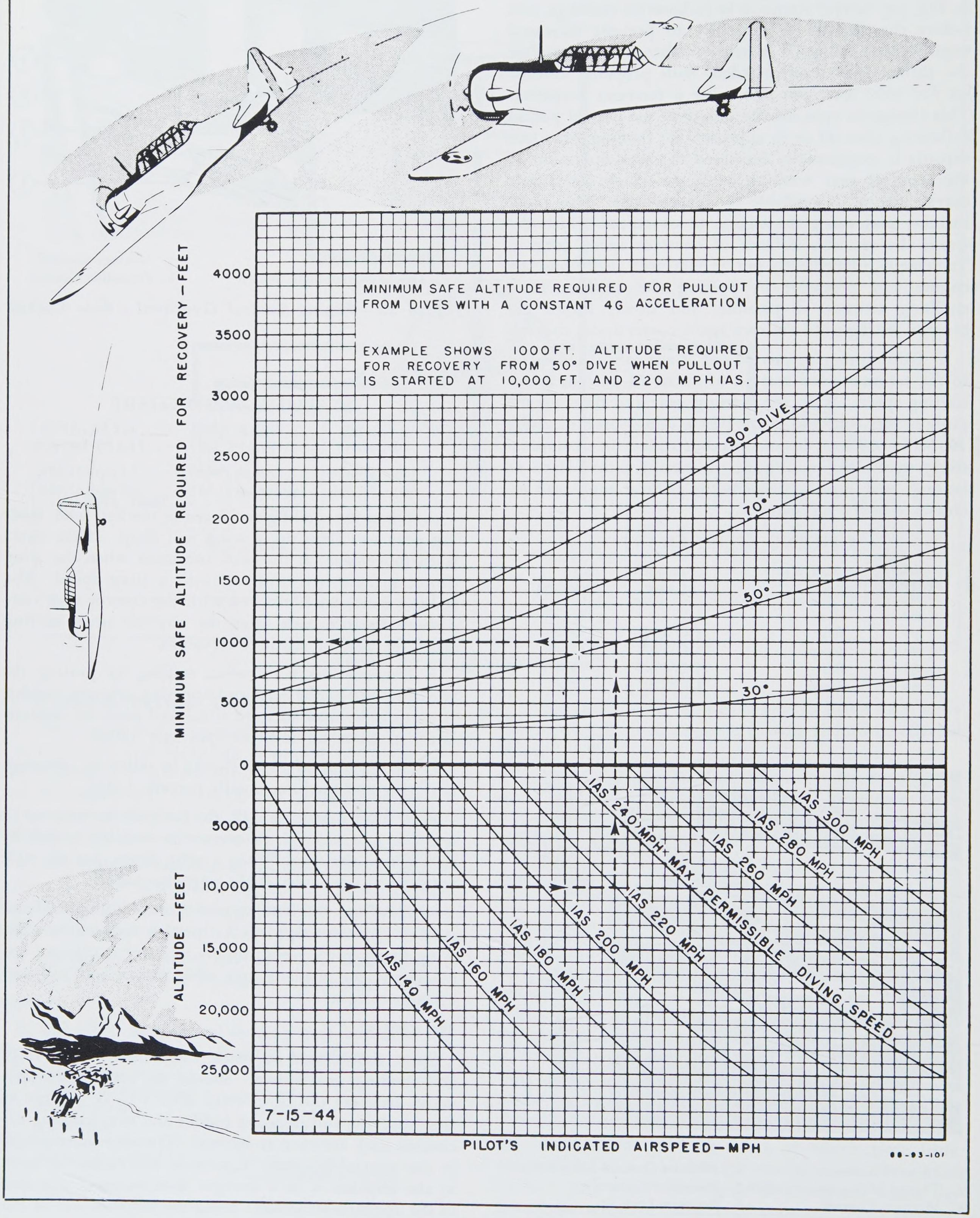


Figure 23 — Diving Speed Chart

14. PERMISSIBLE ACROBATICS.

The acrobatic qualities of this airplane are exceptional, and the lateral control is excellent at all speeds. All normal acrobatics except those prohibited in paragraph 1 of this section are permitted; however, inverted flying must be limited to 10 seconds because of engine difficulties resulting from prolonged inverted flight.

15. DIVING.

(See figure 23.)

The maximum permissible diving speed is 240 IAS, during which the engine speed must not exceed 2800 rpm and 20 in. Hg with the throttle open 1/3 or more. However, with the throttle closed, 2200 rpm is the maximum allowable to keep engine stresses down. The propeller must be in the "DECREASE RPM" position in a dive. Move the control to "DECREASE RPM" while the throttle is still partially open to prevent the propeller blades from remaining set in "INCREASE RPM" during the dive. The use of elevator tabs is not required for dive recovery.

16. NIGHT FLYING.

The sequence outlined for daylight operation should be observed even more strictly for night flights. In addition, the pilot should familiarize himself with the location of the different lights and their switches.

17. APPROACH AND LANDING.

(See figure 24.)

a. APPROACH.—When the airplane approaches the field, adhere to the following sequence of operation:

(1) Check lap belt, tighten and lock shoulder harness.

(2) Place fuel selector on "RESERVE". *(See figure 18.)*

(3) Set mixture control *(3 figure 21)* in full *"RICH"*.

(4) Set propeller control *(5 figure 21)* in the maximum cruising rpm position (2000 rpm).

(5) Reduce speed to less than 150 MPH IAS.

(6) Press the power control lever *(1 figure 5)*.

(7) Lower the landing gear by placing the landing gear control *(4 figure 5)* in the "DOWN" position. Leave the control in the "DOWN" position.

(8) Reduce speed to less than 126 MPH IAS.

(9) Lower the flaps at 95 MPH IAS as needed on final approach after the turn into the field has been made. The flaps are lowered by placing the flap control *(2 figure 5)* in the "DOWN" position and leaving it there.

b. LANDING.

(1) GENERAL.—Having turned into the field and lowered the flaps, adjust the rudder and elevator trim tabs *(8 figure 5)* to maintain a correct gliding speed. Having stopped after landing, raise the flaps and unlock the tail wheel before taxiing.

(2) CROSS-WIND LANDING.—As this airplane has a landing gear of wide tread, cross-wind landings may be negotiated safely. Keep one wing down, into the wind, to counteract drift.

(3) TAKE-OFF IF LANDING IS NOT COMPLETED.—In the event of an unsuccessful attempt to land, open the throttle and take off. Raise the landing gear immediately; then, when the air speed has reached

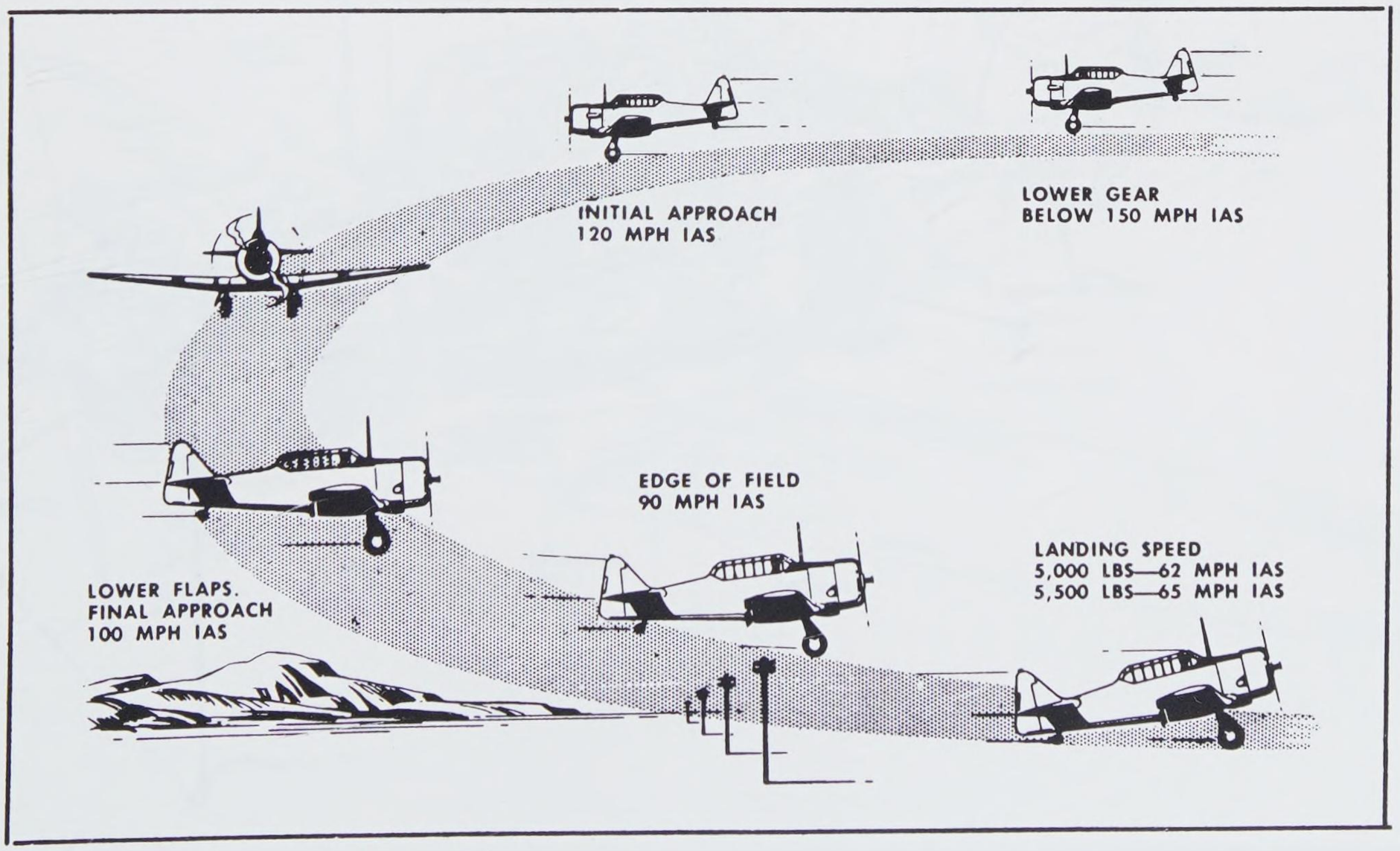


Figure 24—Landing Diagram

100 MPH IAS and with an altitude of at least 300 feet, raise the flaps *(2 figure 5)*.

18. STOPPING OF ENGINE.

a. If a cold weather start is anticipated, dilute the engine oil as outlined in paragraph 3 of this section.

b. Open the throttle to about 1200 rpm and put propeller control *(5 figure 21)* at "DECREASE RPM"; allow engine to run for one minute.

c. Place mixture control *(3 figure 21)* in full "LEAN", making use of idle cut-off.

d. Place throttle *(1 figure 21)* in full "OPEN".

e. Turn ignition switch *(33 figure 7)* "OFF" after engine ceases firing.

f. Turn fuel selector "OFF". *(See figure 18.)*

19. BEFORE LEAVING COCKPIT.

After engine stops, proceed as follows:

a. Turn "OFF" all switches.

b. Move throttle to "CLOSED".

c. Lock the surface controls. *(See figure 17.)*

d. Apply parking brakes*(61 figure 7)* when brakes have cooled sufficiently.

20. MOORING.

(See figure 25.)

a. Head the airplane into the wind.

b. Set parking brakes.

c. Lock the surface controls.

d. Insert the mooring rings in the wings. Moor the airplane to ground mooring rings or sandbags with 3/4-inch rope or 1/4-inch cable. Secure the tail at the lift-mooring tube or by lashing directly to the tail wheel fork.

e. Install covers.

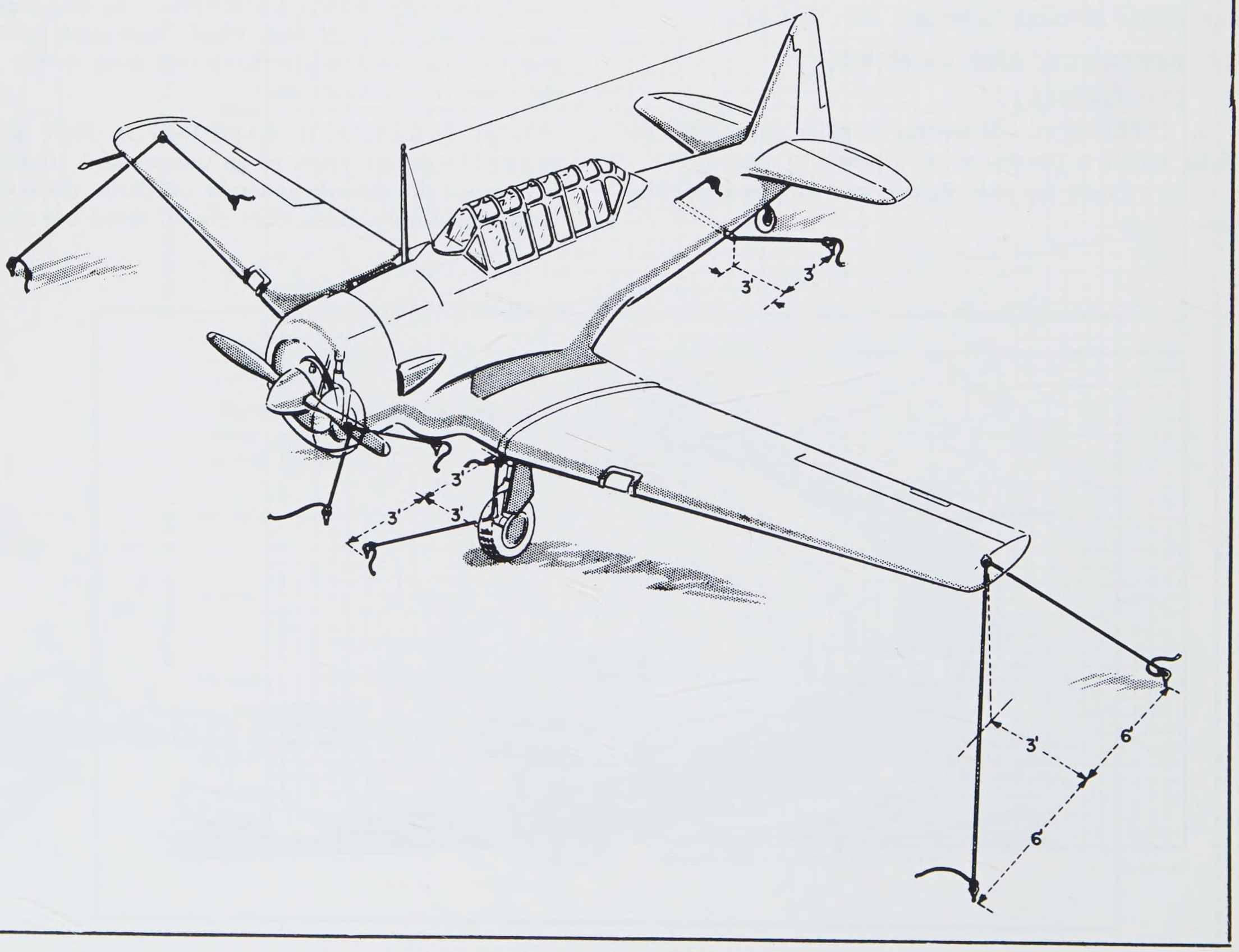


Figure 25 — Mooring Airplane

SECTION III
FLIGHT OPERATING DATA

1. POWER PLANT CHART.

a. Operating limitations and characteristics of the R-1340-AN-1 engine are summarized on the "Power Plant Chart". The pilot should be thoroughly familiar with this information.

b. Engine operating conditions shown on the chart are defined as follows:

(1) WAR EMERGENCY.—Not applicable.

(2) MILITARY POWER. — Maximum recommended for operation for periods not exceeding 5 minutes.

(3) NORMAL RATED.—Maximum recommended for operation with rich mixture in climb and level flight.

(4) MAXIMUM CRUISE. — Maximum recommended with lean mixture.

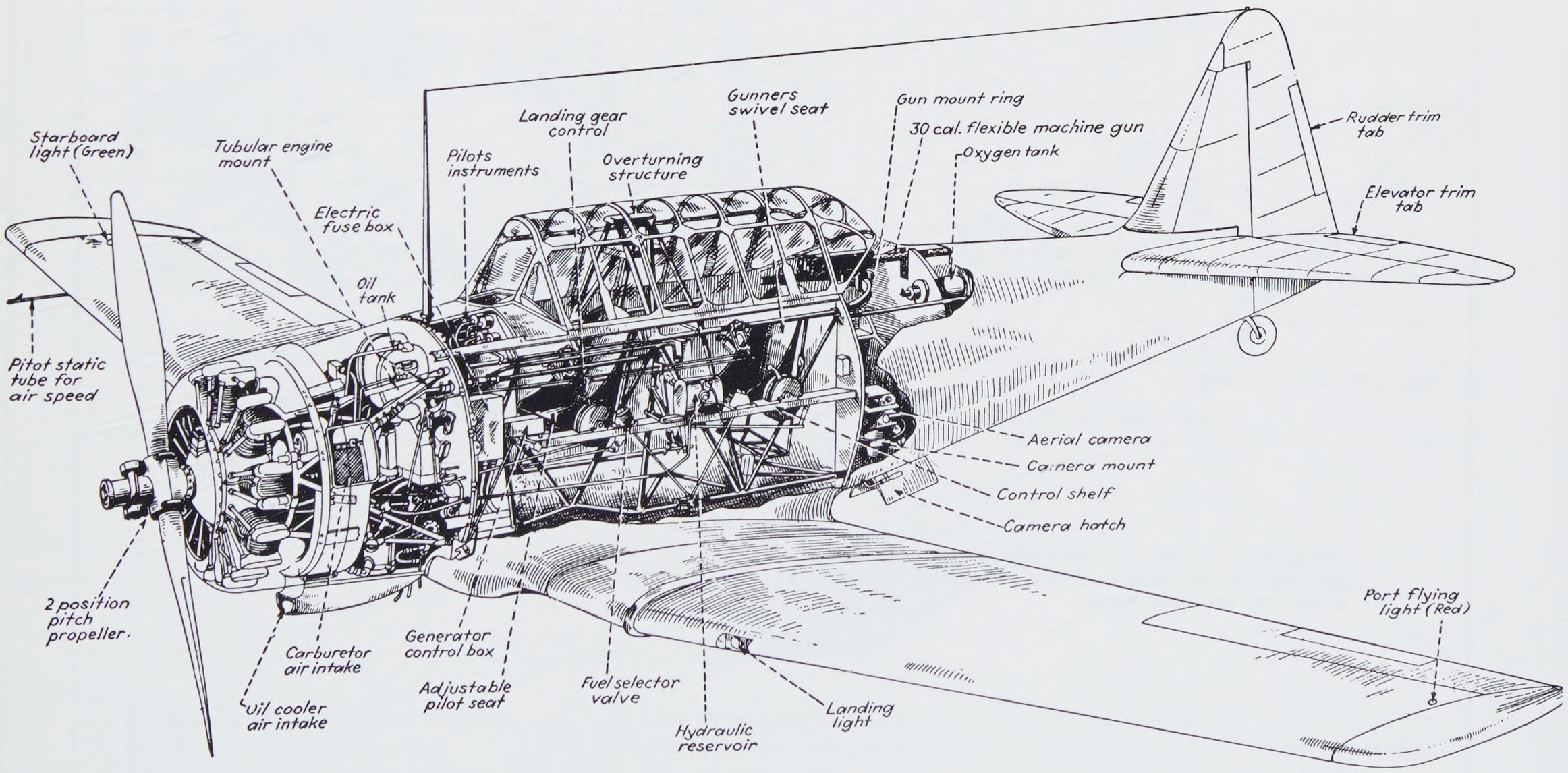
(5) TAKE-OFF CONDITIONS. — Maximum recommended for take-off under the specified time limit of 5 minutes.

2. AIR SPEED LIMITATIONS.

Refer to section II, paragraph 1.

3. AIR SPEED CORRECTION TABLE.

IAS MPH	CALIBRATED AIR-SPEED (MPH)	ALTIMETER ERROR ADD TO INSTRUMENT READING	
		S. L.	15,000
80	80	0	0
100	101	10	10
120	122.5	20	30
140	144	40	60
160	165.5	60	100
180	187	90	140
200	208.5	120	190
220	230		
240	251		



POWER PLANT CHART

AIRCRAFT MODEL(S)
AT-6
SNJ

PROPELLER(S)
12D40

ENGINE MODEL(S)
R-1340-AN-1

GAUGE READING	FUEL PRESS.	OIL PRESS.	OIL TEMP.	COOLANT TEMP.		OIL[1] CONS.
DESIRED MAXIMUM	3-5	50-70 100	70 95			7.5
MINIMUM IDLING	3 2	50 15				

MAXIMUM PERMISSIBLE DIVING RPM: 2800
MINIMUM RECOMMENDED CRUISE RPM: 1600
MAXIMUM RECOMMENDED TURBO RPM:

OIL GRADE: (S) 1120 (W) 1100
FUEL GRADE: 87 SPEC. AN-F-25

WAR EMERGENCY (COMBAT EMERGENCY)			MILITARY POWER (NON-COMBAT EMERGENCY)			OPERATING CONDITION			NORMAL RATED (MAXIMUM CONTINUOUS)			MAXIMUM CRUISE (NORMAL OPERATION)		
MINUTES			5 MINUTES			TIME LIMIT			UNLIMITED			UNLIMITED		
			260°C			MAX. CYL. HD. TEMP.			260°C			232°C		
			RICH 2250			MIXTURE R. P. M.			RICH 2200			LEAN 2000		
MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	STD. TEMP. °C	PRESSURE ALTITUDE	STD. TEMP. °F	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]
						-55.0	40,000 FT.	-67.0						
						-55.0	38,000 FT.	-67.0						
						-55.0	36,000 FT.	-67.0						
						-52.4	34,000 FT.	-62.3						
						-48.4	32,000 FT.	-55.1						
						-44.4	30,000 FT.	-48.0						
						-40.5	28,000 FT.	-40.9						
						-36.5	26,000 FT.	-33.7						
						-32.5	24,000 FT.	-26.5						
						-28.6	22,000 FT.	-19.4						
			F.T.		.5	-24.6	20,000 FT.	-12.3	F.T.		33	F.T.		25
			F.T.		.5	-20.7	18,000 FT.	- 5.2	F.T.		35	F.T.		27
			F.T.		.5	-16.7	16,000 FT.	2.0	F.T.		37	F.T.		29
			F.T.		.5	-12.7	14,000 FT.	9.1	F.T.		40	F.T.		31
			F.T.		1.0	- 8.8	12,000 FT.	16.2	F.T.		43	F.T.		33
			F.T.		1.0	- 4.8	10,000 FT.	23.4	F.T.		46	26.0		35
			F.T.		1.0	- 0.8	8,000 FT.	30.5	F.T.		49	26.5		35
			F.T.		1.0	3.1	6,000 FT.	37.6	F.T.		53	27.5		34
			F.T.		1.0	7.1	4,000 FT.	44.7	32.5		54	28.5		34
			35.0		1.0	11.0	2,000 FT.	51.8	32.5		52	29.0		34
			36.0		1.0	15.0	SEA LEVEL	59.0	32.5		49	30.0		34

GENERAL NOTES

[1] OIL CONSUMPTION: MAXIMUM U.S. QUART PER HOUR PER ENGINE.
[2] *Gal/Min:* APPROXIMATE U.S. GALLON PER *MINUTE* PER ENGINE
[3] GPH: APPROXIMATE U.S. GALLON PER HOUR PER ENGINE.
F.T.: MEANS FULL THROTTLE OPERATION.
VALUES ARE FOR LEVEL FLIGHT WITH RAM.

FOR COMPLETE CRUISING DATA SEE APPENDIX II
NOTE: TO DETERMINE CONSUMPTION IN BRITISH IMPERIAL UNITS, MULTIPLY BY 10 THEN DIVIDE BY 12.

TAKE-OFF CONDITIONS:
2250 RPM AND 36" HG

CONDITIONS TO AVOID:
OPERATION BELOW 1500 RPM

SPECIAL NOTES

1. ***THE MIXTURE CONTROL IN THIS AIRPLANE IS NOT AUTOMATIC AND MUST BE ADJUSTED MANUALLY TO OBTAIN SMOOTH ENGINE OPERATION AND BEST RANGE.***

DATA AS OF *8-10-44* BASED ON *FLIGHT TESTS*

AAFMC-526
4-1-44

Figure 26 — Power Plant Chart

SECTION IV
EMERGENCY OPERATING INSTRUCTIONS

1. GENERAL.

Emergency instructions have been assembled in this section to facilitate quick reference. The pilot should acquaint himself with these instructions before his first flight in this airplane.

2. SCRAMBLE TAKE-OFF

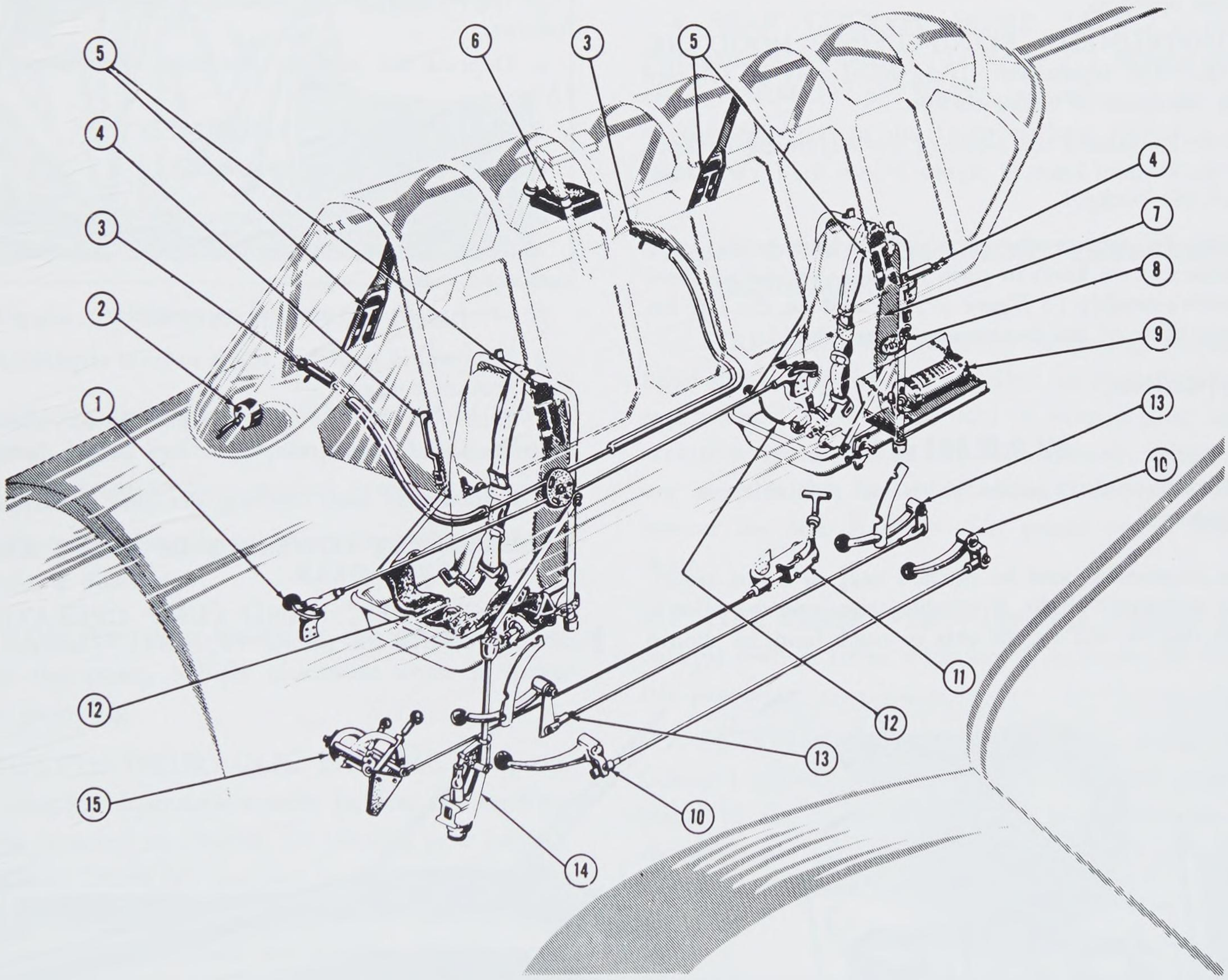
Refer to section II paragraph 6.

3. ENGINE FAILURE DURING TAKE-OFF.

Refer to section II, paragraph 9.

4. ENGINE FAILURE DURING FLIGHT.

If the engine fails during flight, the airplane may be abandoned, ditched, or brought in for a dead-stick landing. Maintain speed by depressing the nose at once, if necessary, so that the air speed does not drop below 95 IAS. Place propeller control in "DECREASE RPM" to reduce drag. Do not attempt sideslips or "S" turns below 2000 feet altitude. Lowering of the flaps may be de-



1. Instrument Flying Hood Release
2. Fuel Pressure Signal Lamp
3. Instrument Flying Hood Latch
4. Enclosure Latch
5. Emergency Escape Window Latch
6. Landing Gear Warning Horn
7. Life Preserver Cushion
8. Fire Extinguisher Door Lock
9. Fire Extinguisher
10. Hand Fuel Pump Handle
11. Rear Cockpit Bomb Salvo
12. Safety Belt
13. Landing Gear Control Handle (Emergency Lock Position)
14. Hydraulic Hand Pump
15. Front Cockpit Bomb Quadrant

Figure 27 — Emergency Provisions

layed until the last 300 or 400 feet, but keep in mind that once lowered, they can not be raised.

5. EMERGENCY EXIT DURING FLIGHT.

In the event that an emergency exit must be made during flight, the following procedures are recommended:

a. ENCLOSURE.—Release the sliding enclosure by pushing the lever on the left side of the section and pushing the enclosure back. Unfasten safety belt and shoulder harness, lower self onto wing and roll off, or roll airplane over on its back and drop out.

b. EMERGENCY ESCAPE WINDOW.—If the enclosure is inoperative, raise the red release lever at the bottom center of any side enclosure panel *(5 figure 27)*, thus breaking the safety wire, and push the panel clear of the airplane. This should permit the enclosure to be opened easily. As a last resort, exit through the side window opening.

c. INSTRUMENT BLIND-FLYING HOOD RELEASE.—The instrument flying hood may be released by the occupant of either cockpit.

(1) To release the hood of the adjoining cockpit, push the control knob *(1 figure 27)* on the forward left side of the cockpit.

(2) To release the occupied cockpit hood, push the same control knob or push the lever extending from the latch assembly *(3 figure 27)* located on the left below the edge of the instrument panel shield.

6. DITCHING.

WARNING

Be sure to ditch while fuel is still available for power.

The airplane should be ditched only as a last resort. On an overwater flight, if trouble arises and the pilot is certain that he will not be able to reach land, he should leave the airplane in flight. However, if it is not possible to maintain sufficient altitude for a successful parachute drop, ditching is the only remaining procedure. The instructions for ditching are as follows:

a. If bombs are installed, "SALVO" them immediately.

b. Lock the cockpit enclosure in the open position.

c. Landing gear "UP"

d. Flap 20 degrees.

e. Make certain that safety belt and shoulder harness are fastened securely, as there is a violent deceleration of the airplane upon final impact.

f Land fully stalled, tail low, with power if possible. In winds up to 40 MPH land parallel to the swells, in winds over 40 MPH land into the wind.

7. EMERGENCY LANDING.

In the event a forced landing is necessary, proceed as follows:

a. Depress the nose to maintain a minimum of 95 IAS.

b. "SALVO" bombs "UNARMED".

c. Keep landing gear retracted.

d. Check safety belt for security.

e. Use flaps so airplane will glide and land in accustomed manner.

f. Land as nearly upwind as possible.

g. If power is available, use it to level airplane just before ground contact.

h. Turn "OFF" the ignition and battery-disconnect switches and fuel selector valve just before landing.

i. Immediately after landing, get clear of airplane.

8. EMERGENCY LOWERING OF FLAPS AND LANDING GEAR.

a. HYDRAULIC HAND PUMP OPERATION.—The hydraulic hand pump *(14 figure 27)* located to the

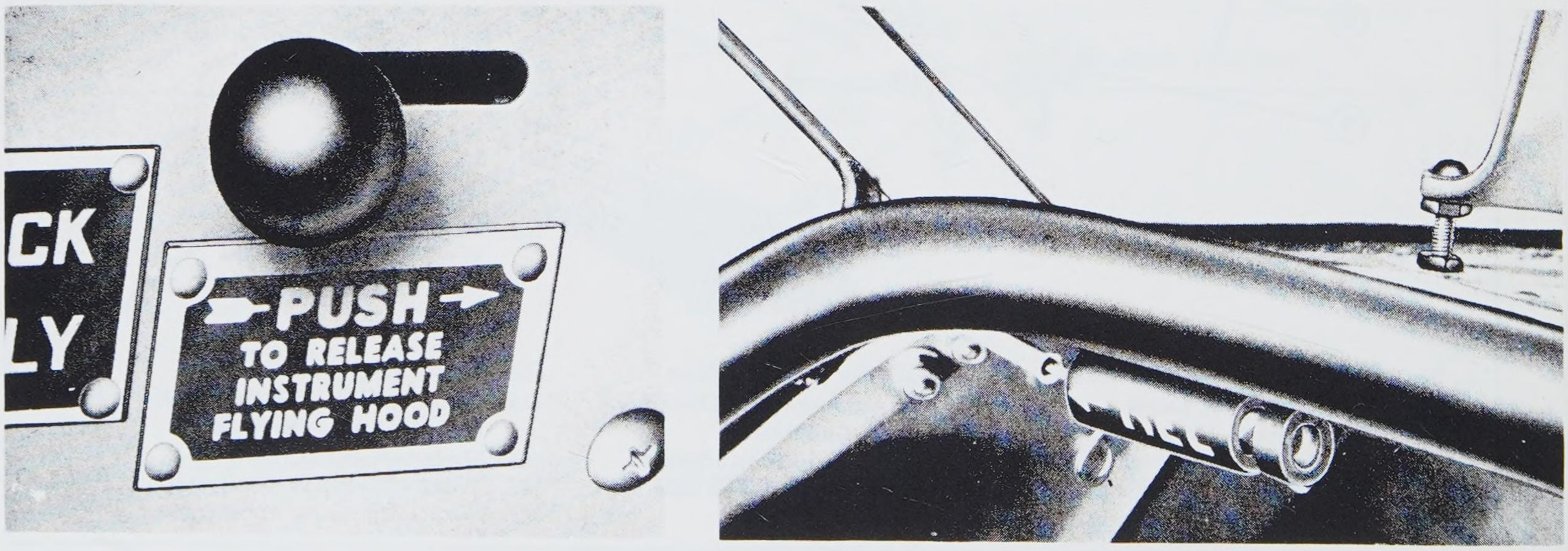


Figure 30 — Instrument Flying Hood Release

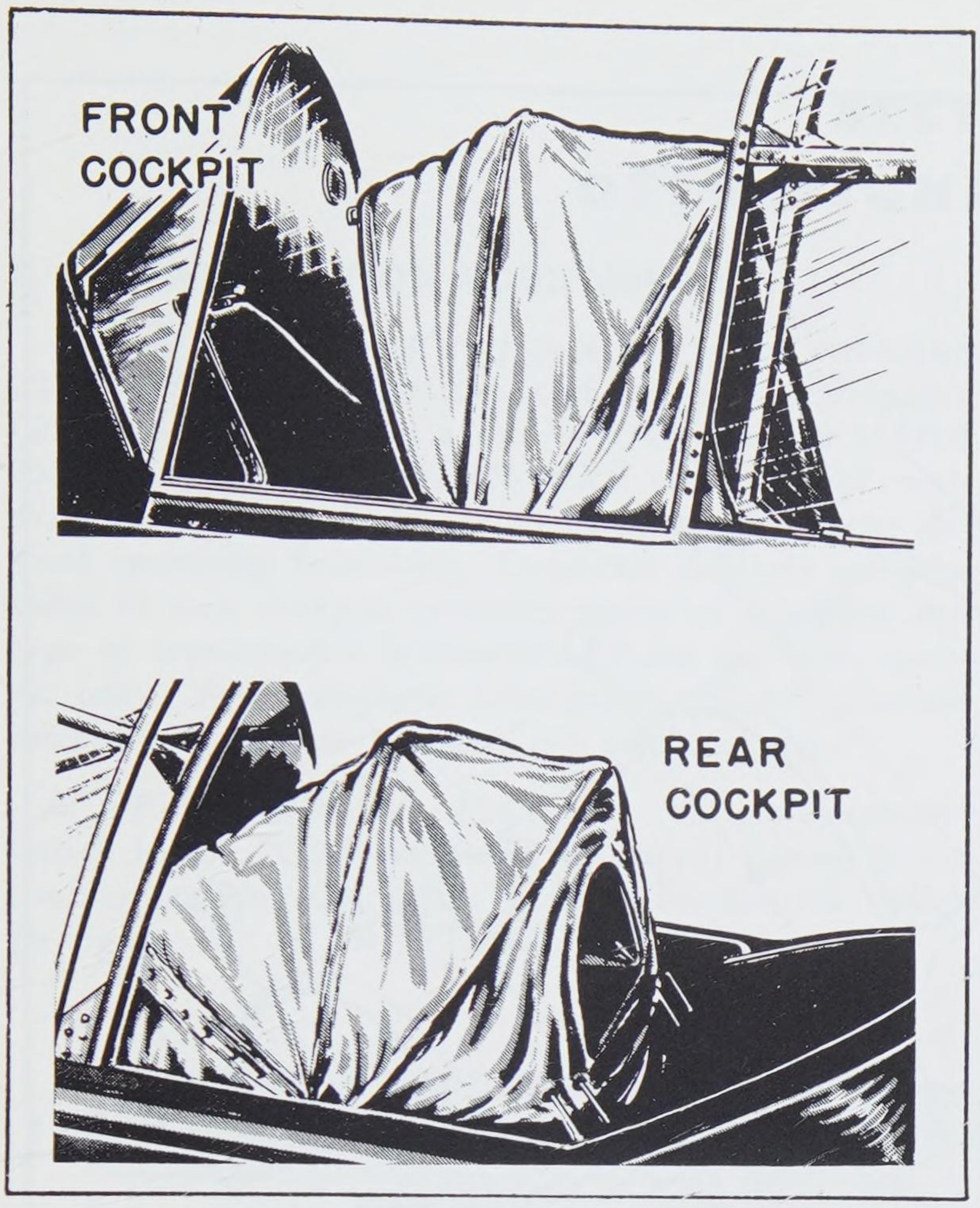


Figure 29 — Instrument Flying Hoods

left of the front cockpit seat is used in event of failure of the engine-driven hydraulic pump. It is not necessary to push the hydraulic power control lever. To operate:

(1) Place the landing gear or flap selector lever in the desired position.

(2) Raise the pump handle to the extended position; turn the pump handle clockwise until it locks, and start pumping.

b. COMPLETE HYDRAULIC FAILURE. — In the event of complete hydraulic system failure, the landing gear may be lowered by placing the landing gear control handle in the "DOWN" position and yawing the airplane. The force of gravity will pull the landing gear to the down position. Place the landing gear control in the "EMERGENCY" locking position *(13 figure 27)* when the indicator shows the gear fully extended. This will mechanically engage the down lockpins. Yaw the airplane again if difficulty in engaging the lockpins is encountered. Flaps cannot be operated in the event of complete hydraulic system failure.

9. ENGINE-DRIVEN FUEL PUMP FAILURE.

Maintain fuel pressure by use of the hand fuel pump *(10 figure 27)* on the control shelf of each cockpit in the event of engine fuel pump failure. Insufficient operation of the hand pump will be indicated by the fuel pressure warning light *(2 figure 27)*. Maintain 3 to 4 lb/sq in. pressure to supply sufficient fuel to the engine.

10. EMERGENCY BOMB RELEASE.

a. FRONT COCKPIT BOMB QUADRANT.

(1) In order to salvo unarmed, place the bomb safety and nose fuse switches to "SAFE". Move the bomb arming lever of the quadrant to "SAFE". *(See 15 figure 27.)*

(2) Move the release lever to "SALVO".

b. REAR COCKPIT BOMB SALVO. — Pull the emergency salvo handle *(11 figure 27)*. Bombs will drop either "ARMED" or "SAFE", according to the position of the switches on the front cockpit electrical control panel.

11. USE OF MISCELLANEOUS EMERGENCY EQUIPMENT.

a. FIRE EXTINGUISHER.—A carbon tetrachloride hand fire extinguisher is installed on the left side of the rear cockpit. *(See figure 30.)* A hinged door makes it accessible from outside also. To remove, release retaining strap buckle and pull outward. Pressing the red button the left fuselage side panel opens the access door.

b. LIFE PRESERVER.—The back cushion of both cockpit seats is filled with kapok and may be used as a life preserver.

c. PYROTECHNICS.—Provisions are made in early Group I airplanes for stowing a type M-2 pyrotechnic pistol at the right side of the front cockpit. Racks alongside are provided for three type M-10 and three type M-11 signals.

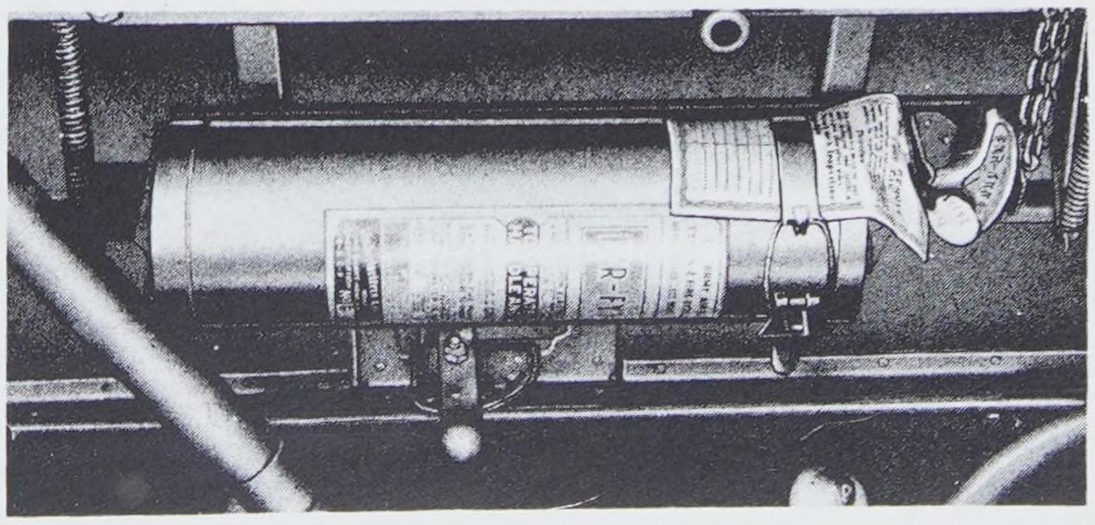
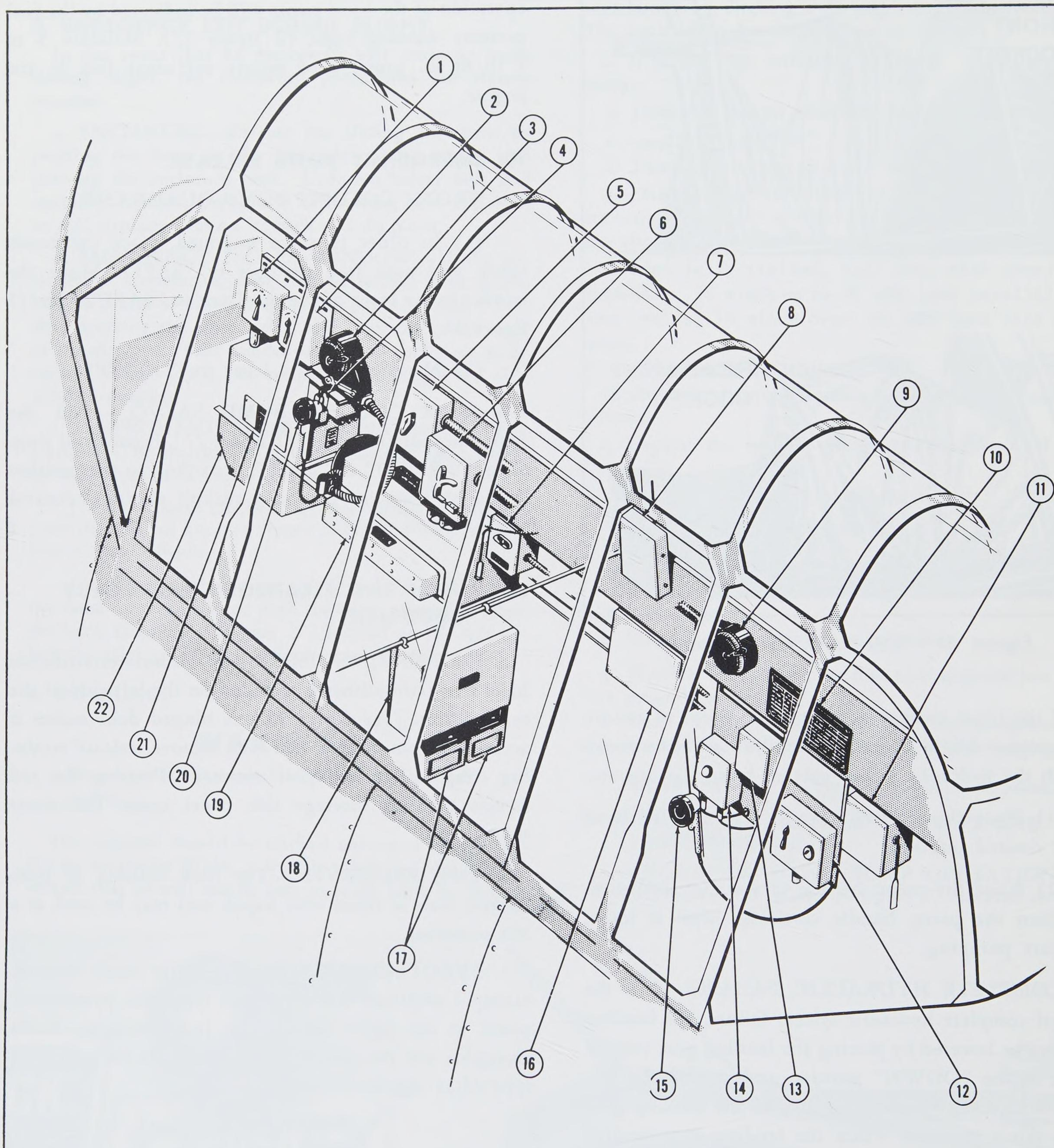


Figure 30 — Fire Extinguisher



1. Transmission Control Box
2. Receiver Control Box
3. Tuning Unit—Front Cockpit
4. Antenna Switching Relay
5. Filter Switch Box
6. Radio—Interphone Switch Box
7. Control Box (British Use)
8. Filter Unit
9. Tuning Unit—Rear Cockpit
10. Calibration Chart
11. Jack Box (British Use)
12. Receiver Control Unit
13. Interphone Control Unit
14. Interphone Box
15. Microphone—Rear Cockpit
16. Interphone Junction Box
17. Interphone Amplifiers
18. Command Set Junction Box
19. Receiver
20. Microphone—Front Cockpit
21. Transmitter
22. Command Set Pull Box

Figure 31 — Communication System

SECTION V
OPERATIONAL EQUIPMENT

1. COMMUNICATION EQUIPMENT.

a. DESCRIPTION. *(See figure 31.)*—The command set SCR-AL-183 installation consists of a transmitter (2500 to 7700 kc) and a receiver (201 to 398 kc and 2500 to 7700 kc), both of which are provided with extra coils and tuning arrangements to obtain the desired operating frequency. Duplicate controls are provided in each cockpit; however choice of reception and type of transmission is controlled from the front cockpit only. An interphone installation, RC-27, provides intercommunication between the two cockpits.

b. OPERATION. — Place the battery-disconnect switch in the "ON" position. To supply power to the communication equipment, place radio control switch *(6 figure 32)* at *"MANUAL"*.

(1) RECEPTION.

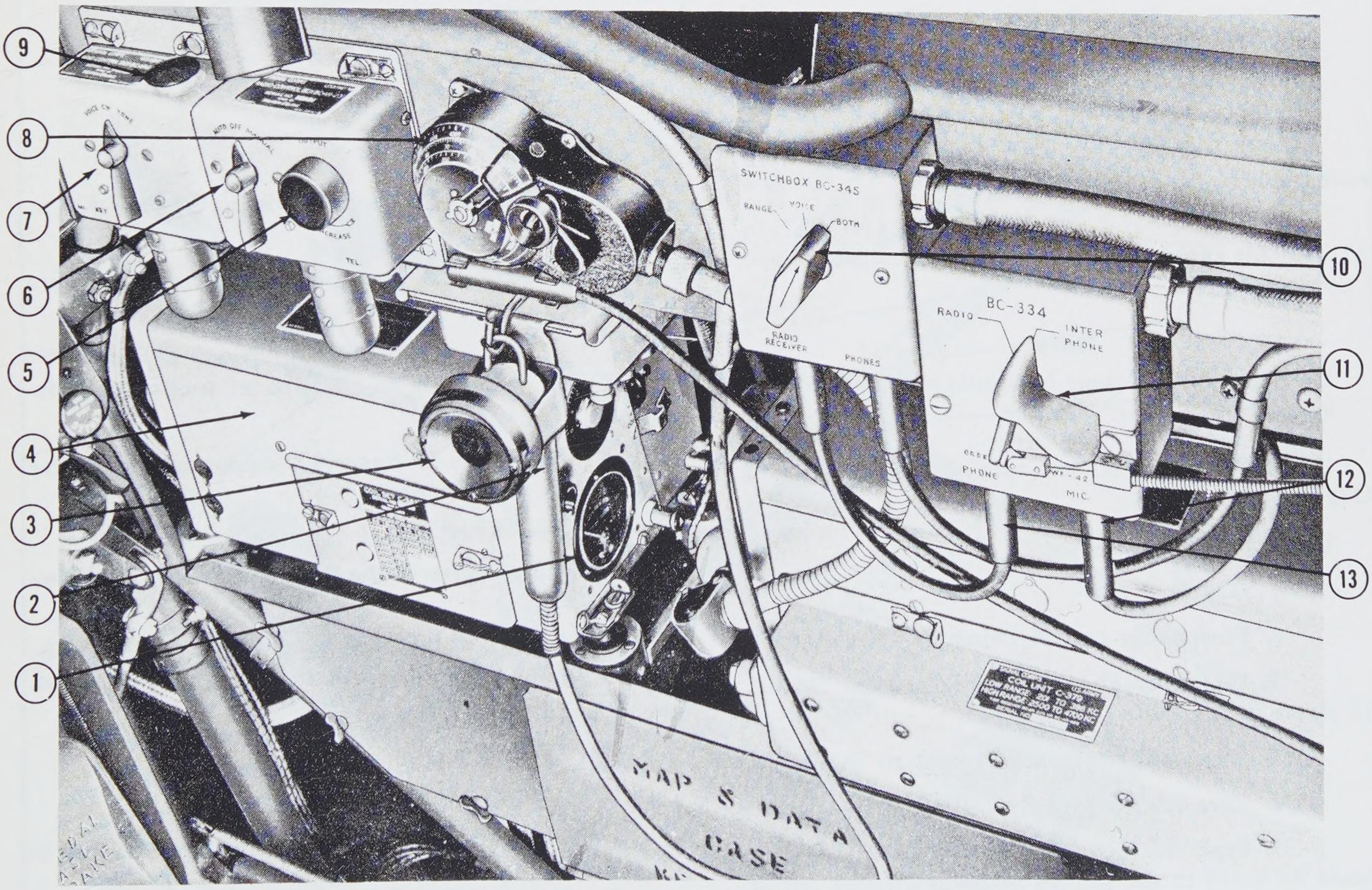
(a) Turn radio-interphone switch *(11 figure 32)* to "RADIO".

(b) Plug headphones into "PHONE" jack *(13 figure 32)*.

(c) Wait 45 seconds for receiver to warm. A hum will be heard in the phones.

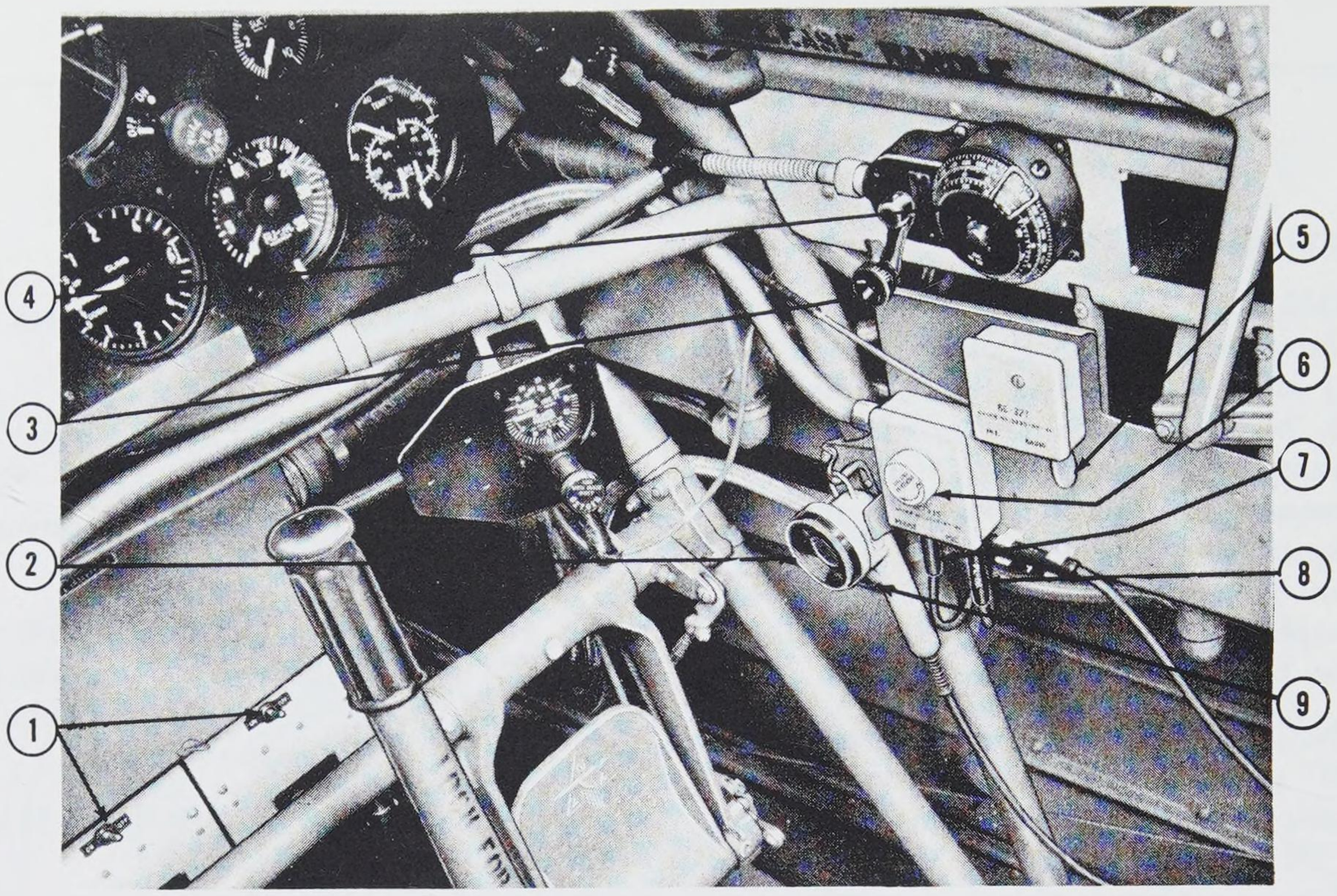
(d) Turn filter selection switch to "RANGE", "VOICE", or "BOTH", depending on type of reception desired. "BOTH" provides reception of "RANGE" and "VOICE" simultaneously.

(e) Use tuning unit *(8 figure 32)* to tune in desired station.



1. Antenna Current Meter
2. Microphone Switch
3. Microphone
4. Radio Transmitter
5. Volume Control
6. Radio Control Switch
7. Transmitter "VOICE-CW-TONE" Switch
8. Tuning Unit
9. Telegraph Key
10. Filter Selection Switch
11. Radio-Interphone Switch
12. Microphone Jack
13. Head Set Jack

Figure 32 — Radio Controls — Front Cockpit



1. Interphone Amplifier Switch
2. Microphone
3. Tuning Handle
4. Tuning Dial
5. Radio—Interphone Switch
6. Volume Control
7. Head Set Jack
8. Microphone Jack
9. Microphone Switch

Figure 33 — Radio Controls — Rear Cockpit

f. Use volume control *(5 figure 32)* to obtain desired volume.

(g) Turn control switch from "MANUAL" to "AUTO" for automatic gain control and adjust volume if necessary.

Note

Do not attempt to tune in signals with control switch in "AUTO" position.

(h) To turn off set, turn control switch to "OFF"

(2) TRANSMISSION.

(a) VOICE.

1. Place radio control switch at "MANUAL".

2. Plug microphone into jack marked "MIC." *(12 figure 32).*

3. Turn radio-interphone switch to "RADIO".

4. Turn selector switch to "VOICE".

5. Press microphone switch to talk. A click should be heard in the phones and the antenna circuit meter should register about .8 amperes.

Note

A throat microphone switch is located on each throttle control. Hand microphones are controlled by a switch on each microphone.

(b) KEY.

1. Place radio control switch *(6 figure 32)* at "MANUAL".

2. Turn radio-interphone switch *(11 figure 32)* to "RADIO".

3. Turn selector switch *(7 figure 32)* to "CW" or "TONE", according to the type of transmission desired.

4. Use key *(9 figure 32)* on top of transmitter control unit to send signal.

(3) INTERPHONE.

(a) Make certain the amplifier switch *(1 figure 33)* is "ON".

(b) Place radio-interphone switch to "INTERPHONE" and use microphone as in voice transmission.

c. PREFLIGHT CHECK.

(1) RECEPTION.

(a) Turn the receiver on.

(b) With engine not running, check reception to determine if stations are being received properly.

(c) With engine running check reception for undue electrical interference.

(2) TRANSMISSION.

(a) Set switches for voice transmission.

(b) Call the local control station or other air-

planes operating from the same base for frequency check and to determine if transmission and reception are satisfactory.

d. SIGNAL FAILURES.

(1) BETWEEN AIRPLANES. — Uninterrupted communication between maneuvering airplanes cannot be expected unless they are close together. Best reception is usually obtained with airplanes in level flight. Vertical banks cause minimum signal strength unless both airplanes bank the same direction. A "dead spot" will be present when the receiving airplane is directly above or below the radio mast of the transmitting airplane.

(2) AIRPLANE TO GROUND.—Usually signal fading (rapid variations) is encountered in proportion with the transmission distance; however it may be present at distances of less than 10 miles. Poor quality signals or reception do not necessarily indicate faulty equipment. Make a test at close range before looking for equipment trouble.

e. POST FLIGHT PROCEDURE.

(1) Throw radio control switch *(6 figure 32)* to "OFF".

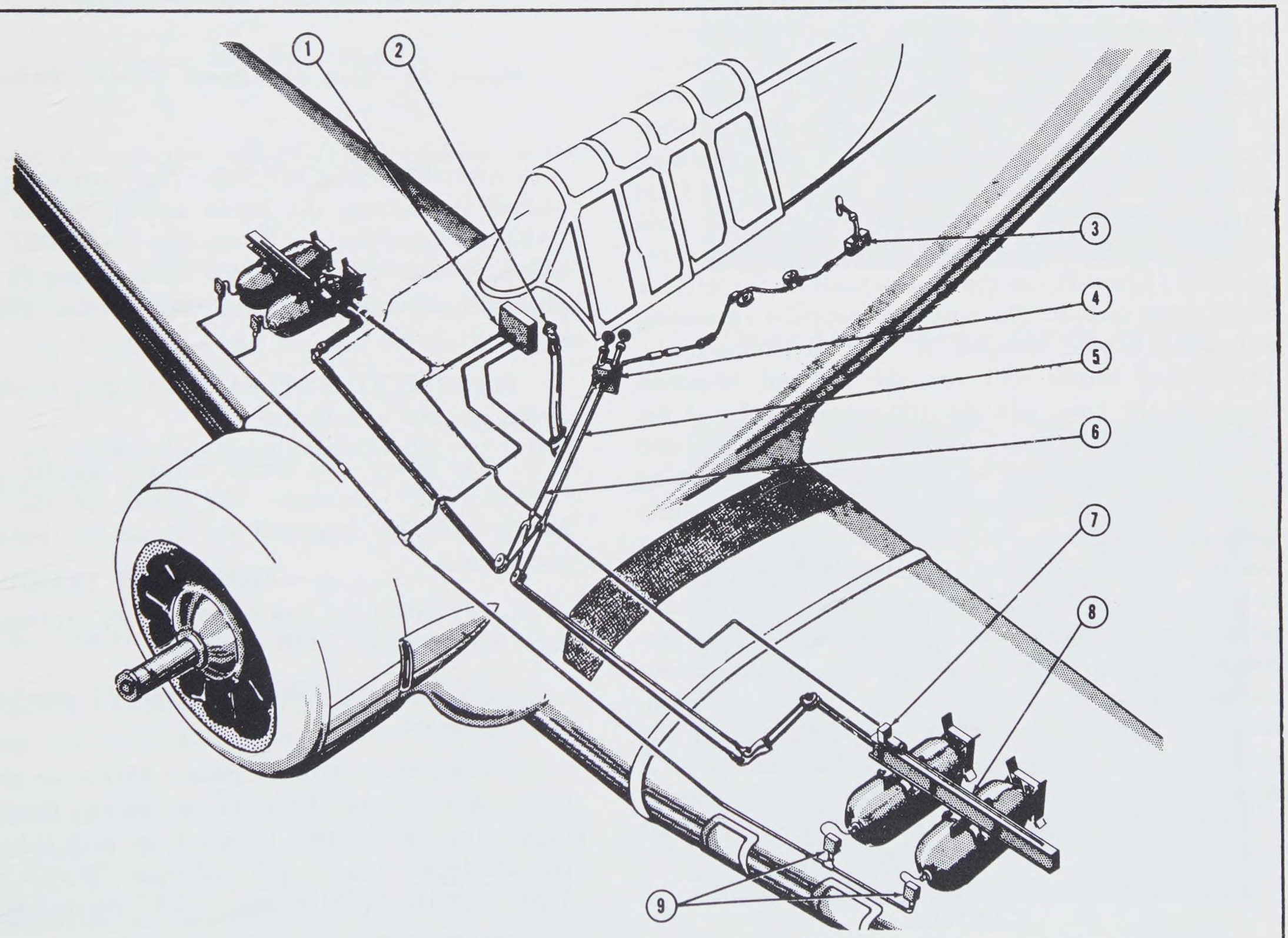
(2) Throw battery-disconnect switch to "OFF".

(3) Securely fasten all loose equipment, head sets, microphones, etc., in their proper places.

2. BOMBING EQUIPMENT.

a. DESCRIPTION.

(1) GENERAL. *(See figure 34.)*—Complete provisions have been incorporated in the airplane for a flush-type bomb rack and other bombing equipment on the lower surface of each outer wing panel. The bomb racks will carry five M-5, 30-pound fragmentation bombs or five M-41, 20-pound fragmentation bombs, either U.S. or British. Two auxiliary bomb shackles may be added to each of these racks for carrying a total of four Mark I, 100-pound bombs, either U.S. or British, in place of the smaller bombs.



1. Bomb Selector and Nose Fuse Switches
2. Bomb Release Switch
3. Rear Cockpit Salvo Release
4. Front Cockpit Bomb Control Quadrant
5. Arming Cable
6. Release Cable
7. Bomb Rack Solenoid
8. Bomb Rack
9. Nose Fusing Solenoids

Figure 34 — Bombing Equipment

(2) SWITCHES. *(See figure 37.)*—Electrical control switches, which consist of one "BOMB SAFETY" switch, two "BOMB SELECTOR" switches, and one "NOSE FUSE" switch, are grouped on the pilot's electrical control panel in the front cockpit.

(a) The "BOMB SAFETY" switch, when "OFF", prevents accidental electrical release of the bombs. The switch must be "ON" before any electrical release can be accomplished.

(b) The "BOMB SELECTOR" switches provide selection of the rack to be employed. "LEFT" or "RIGHT", or "LEFT" and "RIGHT" can be used as desired.

(c) The "NOSE FUSE" switch operates the four type B-1 bomb arming units to nose-arm the 100-pound bombs. A signal lamp, adjacent to this switch, will glow when the 100-pound bombs are nose-armed.

(3) RELEASE.—Release of the bombs, as selected, is accomplished by the push-button type thumb switch *(figure 35)* located on the top of the control stick in the front cockpit. Bombs may be dropped selectively by pushing the control stick release button consecutively. The bombs are released in a definite order, from inboard to outboard and simultaneously on both sides of the airplane when both racks are used together. The "BOMB SAFETY" switch circuits and the firing switch circuits on the control stick are protected from current overloads by two 50-ampere fuses in the main switch panel. Provisions are made for a bomb control quadrant *(figure 38)* on the control shelf on the left side of the front cockpit. This quadrant provides an arming and release handle, stamped "A" and "R", respectively. The arming handle will arm the 20- and 30-pound bombs at the nose, and the 100-pound bombs at the nose or the tail. Except for nose-arming the 100-pound bombs, all arming must be done through this arming handle. The release handle when at "LOCK" position locks the entire system and will prevent release, either electrically or manually, of all bombs. The handle must be moved to "SELECTIVE" position before electrical release can be accomplished. In moving the release handle to "SALVO", all bombs are dropped simultaneously, either in the "ARMED" or "SAFE" condition, according to the setting of the arming handle and the electrical toggle switches. Provision is also made for a release handle in the rear cockpit, beneath the control shelf on the left side, which will only "SALVO" all bombs.

CAUTION

This is for use in an emergency and will release bombs either in the "SAFE" or "ARMED" condition, according to the arming handle and the electrical toggle switches in the front cockpit.

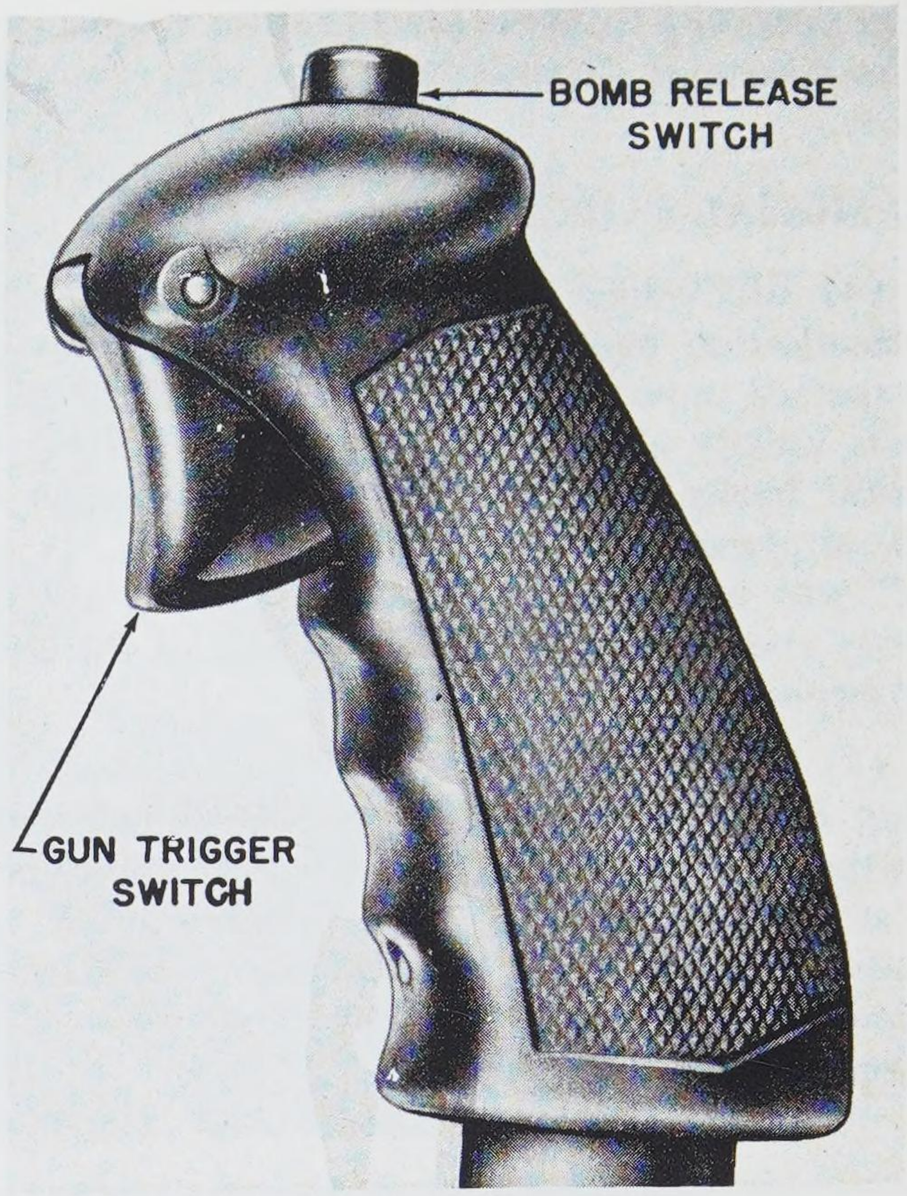


Figure 35—Gun and Bomb Control Switches

b. ARMING PROCEDURE.—Nose arming is accomplished by moving the bomb arming handle to the "ARMED" position and by moving the "NOSE FUSE" switch to the "ON" position. Tail arming is accomplished by moving the arming handle to the "ARMED" position.

(1) SELECTIVE RELEASE.—To drop bombs selectively, proceed as follows:

(a) Move the bomb release handle to the "SELECTIVE" position. The knob on the release handle must be depressed to release the handle for movement.

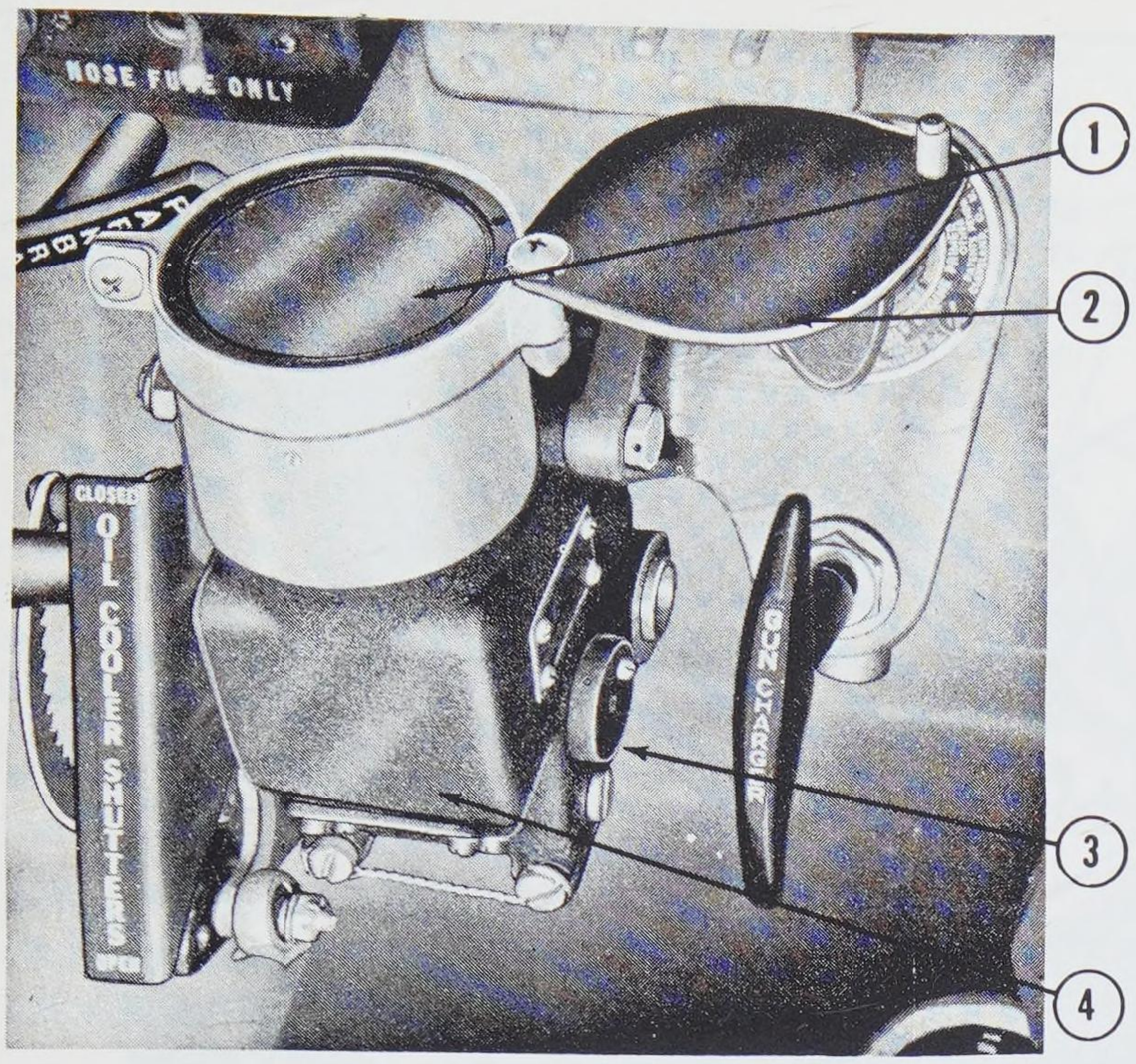
(b) Select the rack to be used by turning "ON" the "BOMB SELECTOR" switch.

(c) Place the "BOMB SAFETY" switch in the "ON" position.

(d) Press the bomb release button on the control stick to release the bomb or bombs. Bombs may be selected for alternate release from each side of the airplane by moving the left and right "BOMB SELECTOR" switches to "ON" and "OFF" alternately.

(2) SALVO RELEASE.—If all bombs are to be dropped simultaneously, proceed as follows:

(a) Press down on the knurled salvo safety ring, located half-way down the release handle, and turn it counterclockwise. This will allow the release handle to



1. Lens Assembly
2. Dust Shield
3. Adusting Knob
4. Sight Housing

Figure 36 — Gun Sight

be moved through the "SELECTIVE" position to the "SALVO" position.

(b) All bombs will drop simultaneously, either "ARMED" or "SAFE", depending on the setting of the arming handle and the position of the nose fuse switch.

(c) Pulling the release handle in the rear cockpit will "SALVO" bombs.

3. GUNNERY EQUIPMENT.

(See figures 35, 36, 37, and 39.)

a. DESCRIPTION.—Gunnery equipment consists of complete provisions for the installation and operation of three model M-2, .30-caliber machine guns: a fuselage gun synchronized to fire through the propeller arc, a gun mounted in the right outer wing panel, and a flexible gun in the rear cockpit. Two hundred rounds of ammunition are supplied each fixed gun from a box mounted adjacent to the gun. Five 100-round ammunition boxes are installed in the rear cockpit to supply the flexible gun. A type N-3B optical gun sight is mounted in the center, directly below the front instrument panel. Gun sight light intensity is controlled by a rheostat to decrease the intensity during night flying. Sight reticle adjustment is effected by a knurled knob on the right side of the sight assembly. Provisions are installed for a type W-7B camera to operate simultaneously with either or both fixed guns. Saftey switches for camera and gun solenoids are located on the front cockpit electrical control panel.

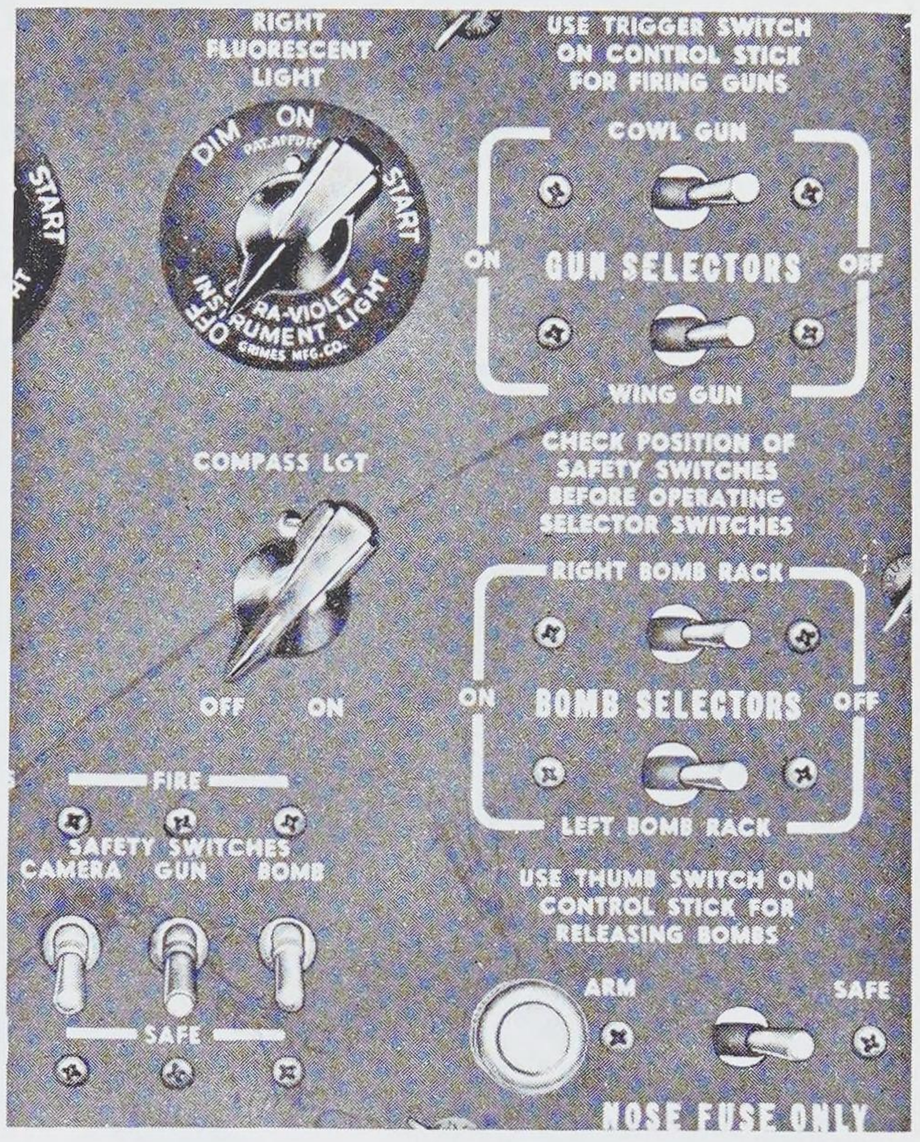
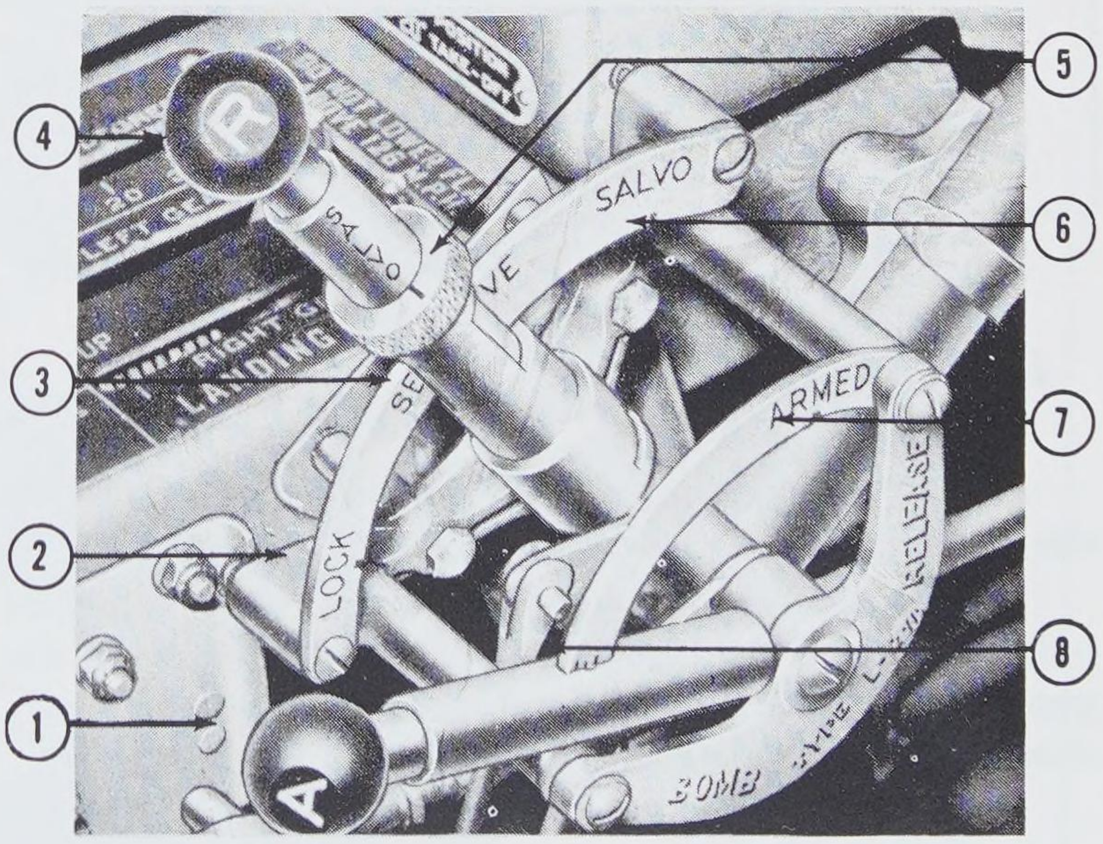
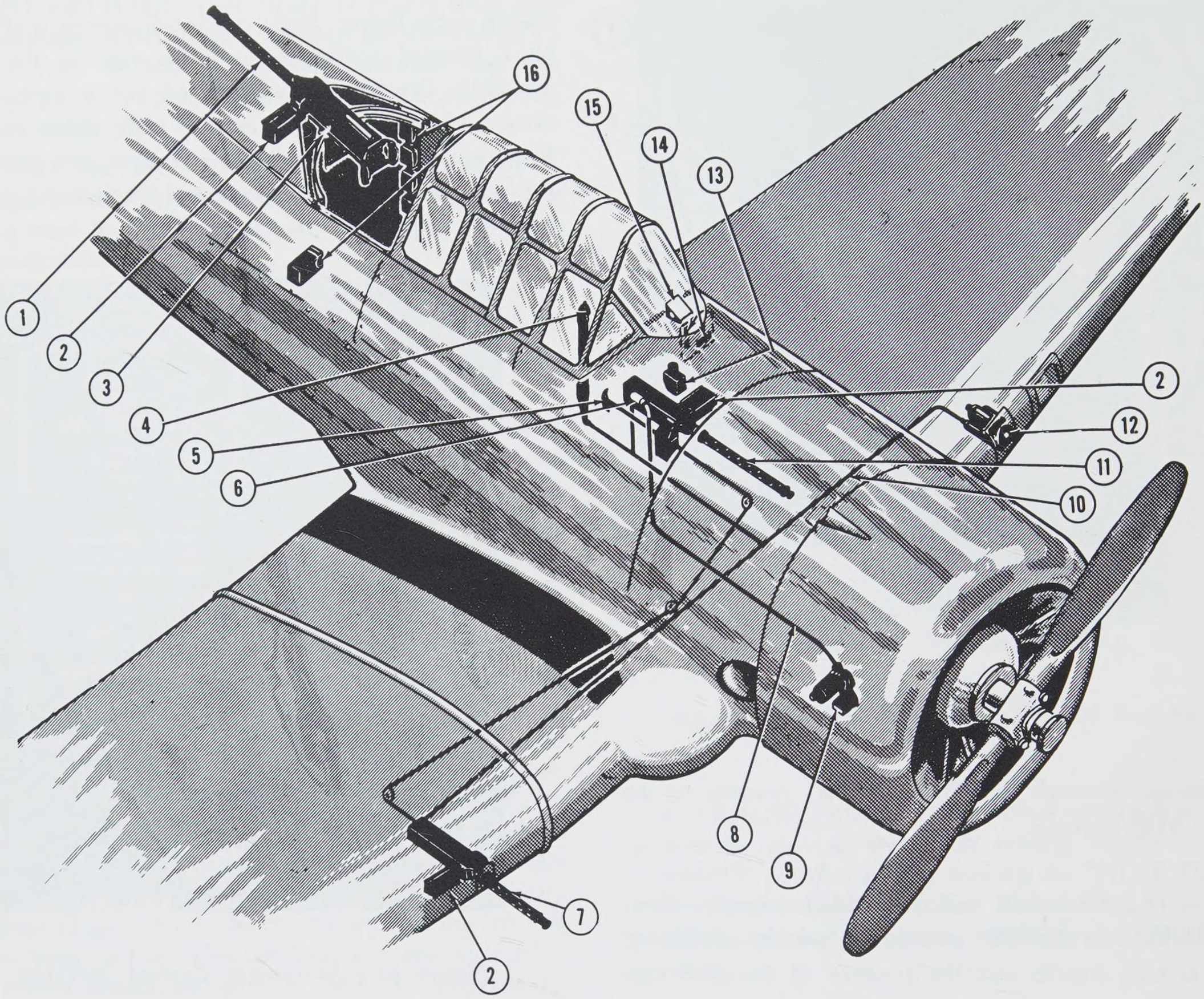


Figure 37 — Armament Control Switches



1. Arming Handle
2. "LOCK" Position
3. "SELECTIVE" Position
4. Release Handle
5. Salvo Safety Ring
6. "SALVO" Position
7. "ARMED" Position
8. "SAFE" Position

Figure 38 — Bomb Control Quadrant



1. Flexible Gun
2. Ammunition Boxes
3. Gun Mount Truck
4. Trigger Switch
5. Wing Gun Charger
6. Trigger Motor
7. Wing Gun
8. Impulse Cable
9. Fuselage Gun Synchronizer
10. Wing Gun and Camera Circuit
11. Fuselage Gun
12. Gun Camera
13. Gun Sight
14. Selector and Safety Switches
15. Gun Sight Reflector Plate
16. Ammunition Stowage Boxes

Figure 39 — Gunnery and Camera Installation

b. OPERATION.

(1) FIXED GUNS.

(a) Charge the fuselage gun by pulling back on the charging handle on the left side of the gun.

(b) Charge the wing gun on late airplanes by pulling back on the charging handle to the right of the gun sight. Wing guns on early airplanes are manually charged when serviced.

(c) Place the selector and safety switches "FIRE."

(d) Fire the guns by squeezing the trigger on the control stick grip.

Note

Put the rear control stick in the stowed position before rotating seat.

(2) FLEXIBLE GUN.

(a) Pull outward on the gun yoke locking knob.

(b) Pull up and back on the gun until the locking knob snaps into place.

(c) Raise the truck-locking handle to move the gun truck along the track.

(d) Lower the handle at the desired position.

(e) Pull back on the charging handle and then release it.

(f) To fire the gun, press the trigger on the hand grip.

4. PHOTOGRAPHIC EQUIPMENT.

a. GUN CAMERA. *(See figure 39.)*—Complete pro-

visions are installed for a type W-7B gun camera in the left outer-wing leading edge near the center sections. The camera is synchronized to fire with the wing or fuselage gun, or both, and is operated by the gun firing switch on the front cockpit control stick. A safety switch is located on the front cockpit electrical control panel. This switch must be in "FIRE" position before camera will operate.

b. AERIAL CAMERA.—Provisions are made for the installation and operation of a type K-3B or K-17 aerial camera and a type A-2 view finder. Controls for the camera consist of a type B-2 intervalometer, a vacuum selector valve, and two warning lights. The intervalometer governs the automatic operation of the camera and is provided with a control knob for setting exposures from 6 to 75 seconds apart. The vacuum selector valve is marked "ON" and "OFF". *(See figure 40.)* When "ON", vaccum holds the film to the focal plane contact glass. A signal light is located on the power junction box near the camera and on the upper front instrument panel to warn the pilot and cameraman 3 seconds before each exposure, when using the intervalometer. Camera doors are also provided below the camera mount in the rear fuselage. To open or close the camera doors, push down on the control handle located on the forward end of each door; then push or pull the handle quickly to engage the doors in an open or closed position, respectively.

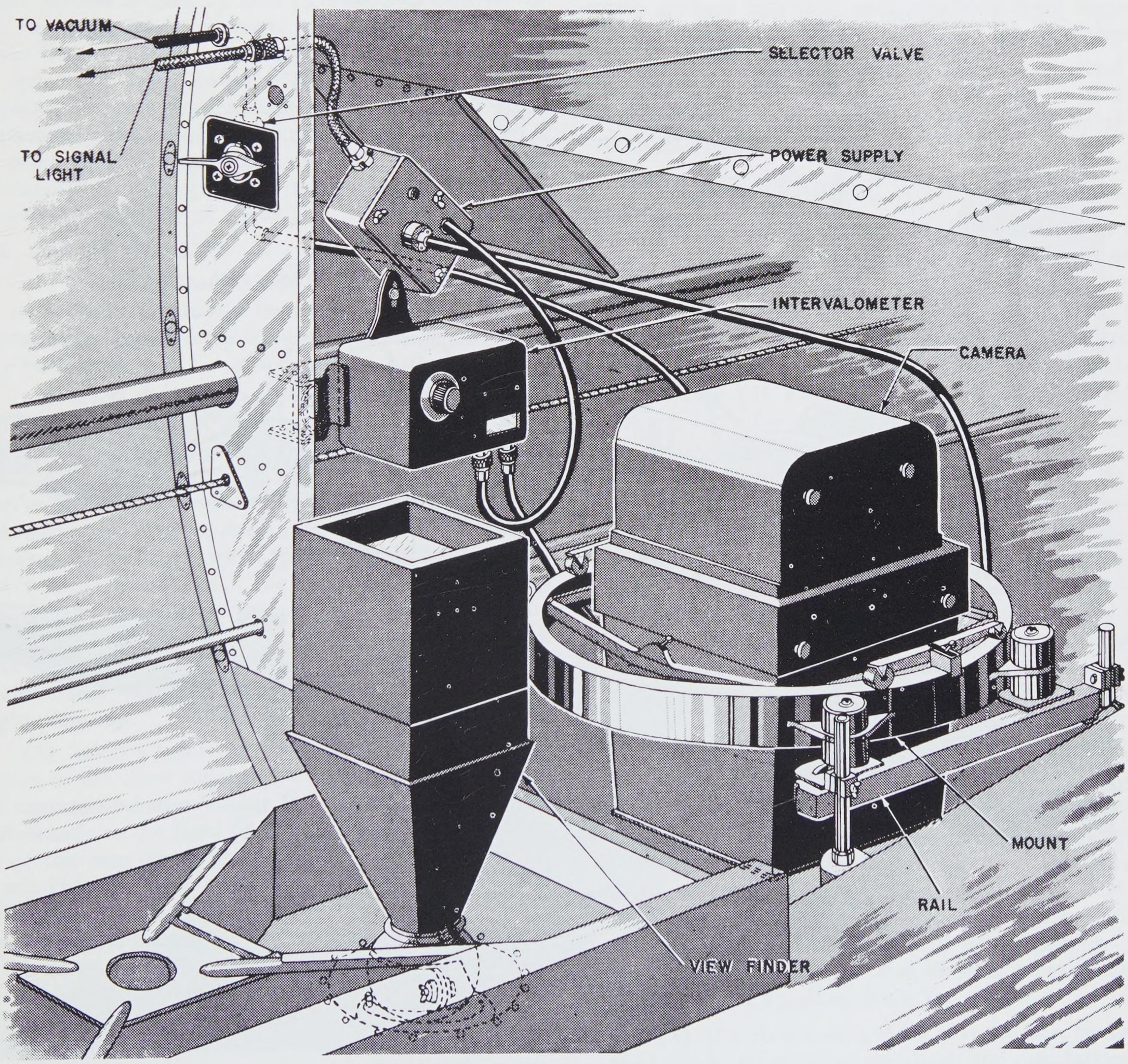


Figure 40 — Aerial Camera Controls

5. OXYGEN EQUIPMENT.

a. DESCRIPTION. *(See figure 41.)* — The high-pressure oxygen system consists of two type B-1 cylinders, two type A-8 regulators (with flow indicator and pressure gage), and the necessary tubing and fittings. The regulator units are installed on the right side of each cockpit. The front cockpit regulator is supplied oxygen by the right cylinder and the rear regulator by the left cylinder. Normal full pressure of each cylinder is 1800 lb/sq in.

b. OPERATION. — Turning the regulator control knob is the only manual operation required in high-pressure oxygen systems. Quantity of oxygen supplied is determined by the position of this control. Open the control knob until the flow indicator reading corresponds with the altitude at which the airplane is flying.

c. CONSUMPTION CHART.—The following table indicates the approximate supply of oxygen in man-hours at designated altitudes when the cylinders are fully charged.

Altitude (in Feet)	Hours Available (1 Man)
10,000	5.05
12,000	4.95
14,000	4.85
16,000	4.60
18,000	4.40
20,000	4.20
22,000	4.05
24,000	3.85
26,000	3.70

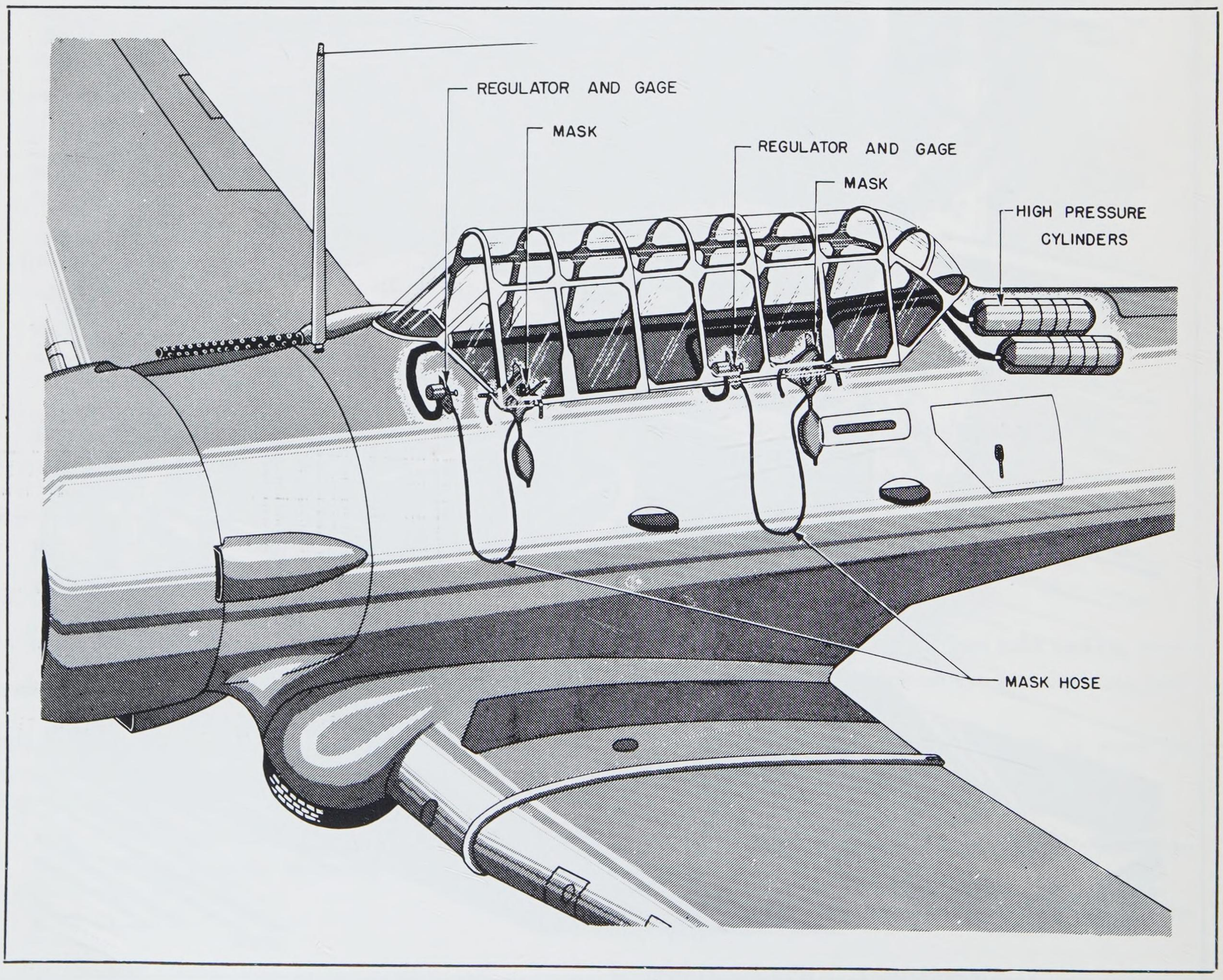


Figure 41 — High Pressure Oxygen System

APPENDIX I
FLIGHT OPERATING CHARTS

1. FLIGHT PLANNING.

a. GENERAL.

(1) A series of charts on the following pages is provided to aid in selecting the proper power and altitude to be used for obtaining optimum range of the airplane. Charts are provided for each airplane configuration with the probable ranges of gross weights.

(2) If the flight plan calls for a continuous flight where the desired cruising power and air speed are reasonably constant after take-off and climb and the external load items are the same throughout the flight, the fuel required and flight time may be computed as a single section flight. If this is not the case, the flight may be broken up into sections, and each leg of the flight planned separately, since dropping of external bombs causes considerable changes in range and air speed for given power. (Within the limits of the airplane, the fuel required and flying time for a given mission depend largely upon the speed desired. With all other factors remaining equal in an airplane, speed is obtained at a sacrifice of range, and range is obtained at a sacrifice of speed.)

b. USE OF CHARTS.

(1) Although instructions for their use are shown on the "Flight Operation Instruction Charts", the following expanded information on proper use of the charts may be helpful.

(2) Select the "Flight Operation Instruction Chart" for the model airplane, gross weight, and external loading to be used at take-off. The amount of gasoline available for flight planning purposes depends upon the reserve required and the amount required for starting and warm-up. Reserve should be based on the type of mission, terrain over which the flight is to be made, and weather conditions. The fuel required for climb and time to climb to various altitudes is shown on the "Take-Off, Climb, and Landing Chart". Fuel remaining after subtracting reserve, warm-up, and climb fuel from total amount available is the amount to be used for flight planning.

(3) Select a figure in the fuel column in the upper section of the chart equal to, or the next entry less than, the amount of fuel available for flight planning. Move horizontally to the right or left and select a figure equal to, or the next entry greater than, the distance (with no wind) to be flown. Operating values contained in the lower section of the column number in which this figure appears represent the highest cruising speeds possible at the range desired. It will be noted that the ranges listed in column I are figured for the altitude which gives the least miles per gallon. The ranges shown in column II and other columns to the right of column II can be obtained at any of the altitudes listed in the Altitude column. All of the power settings listed in a column will give approximately the same number of miles per gallon if each is used at the altitude shown on the same horizontal line with it. Note that the time required for the flight may be shortened by selection of the higher altitudes. The flight duration may be obtained by dividing the true air speed of the flight altitude into the air miles to be flown.

(4) The flight plan may be readily changed at any time en route, and the chart will show the balance of range available at various cruising powers by following the "Instructions for Using Chart" printed on each chart.

Note

The above instructions and following charts do not take into account the effect of wind. Adjustments to range values and flight duration to allow for wind may be made by any method familiar to the pilot, such as by the use of a flight calculator or a navigator's triangle of velocities.

c. SAMPLE PROBLEM.

(1) To fly 450 miles at a cruising altitude of 9000 feet with a take-off weight of 5500 pounds and no external load, the flight should be planned as follows:

(a) The fuel used for take-off and climb to 9000 feet is 15 gallons (using the data listed under 10,000 feet). Adding to this fuel the amount for landing and reserve (15 gallons) makes a total of 30 gallons not available for cruising. Thus there are 81 gallons for cruising (111—30 = 81).

(b) The range shown in column IV for 80 gallons is 470 miles or approximately 20 miles reserve.

(c) Vertically below in the table and opposite 10,000 feet (since 9000 feet is not listed) read 1800 rpm, full throttle, 180 mph true speed, and a fuel flow of 30 gph with the mixture in lean operation. Range to be traveled divided by true air speed equals the hours of flight (450 ÷ 180 = 2.5 hours). Hours multiplied by fuel flow equals the gallons used (2.5 × 30 = 75 gallons). Thus the fuel reserve is 81 less 75 or 6 gallons.

(2) As an alternate plan, reference to column V for maximum range at the extreme right of chart shows that the flight may be made with a sacrifice of 30 mph speed if more reserve is desired. The operating conditions in this case are 1600 rpm, 23 in. Hg manifold pressure, 155 mph true air speed at 23 gph fuel consumption. Under this plan, the time required will be 2.9 hours and the fuel used will be 67 gallons. Thus the time required will be .4 of an hour longer than (1) and will leave 8 gallons more for reserve.

(3) If arrival over a check point is late, because of head winds, reference to the charts and calculations will allow the pilot while in flight to select new cruising conditions for safe arrival at his destination.

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AIRCRAFT MODEL(S)

AT-6
SNJ

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL(S)

R-1340-AN-1

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND	HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET	
	M.P.H. / KTS.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
6000	0 / 0	1000	1700	1300	2000	1500	2400	1100	1800	1400	2200	1600	2500	1300	2100	1700	2500	2100	3000
	17 / 15	700	1200	800	1400	1000	1700	700	1300	900	1500	1100	1800	900	1400	1100	1700	1400	2100
	34 / 30	400	800	500	900	600	1100	400	800	500	1000	700	1200	500	900	600	1100	800	1400
	51 / 45	200	500	200	600	300	700	200	500	300	600	400	700	200	500	300	700	500	800
5500	0 / 0	900	1500	1000	1800	1300	2000	900	1600	1100	1800	1400	2100	1100	1700	1400	2100	1700	2500
	17 / 15	500	1000	700	1200	800	1400	600	1100	700	1300	900	1500	700	1200	900	1400	1100	1700
	34 / 30	300	700	400	800	500	900	300	700	400	800	500	1000	400	700	500	900	700	1100
	51 / 45	100	400	200	500	300	600	200	400	200	500	300	600	200	400	200	500	300	700

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75°F + 10%; 100°F + 20%; 125°F + 30%; 150°F + 40%

DATA AS OF 8-10-44 BASED ON: FLIGHT TESTS

OPTIMUM TAKE-OFF WITH 2250 RPM, 36 IN.HG. & DEG.FLAP IS 80% OF CHART VALUES

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL				AT 5000 FEET					AT 10,000 FEET					AT 15,000 FEET					AT 20,000 FEET					AT FEET				
	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	GAL. OF FUEL USED	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED
6000	115	100	1050	8	115	100	1100	5.0	12	115	100	800	10.0	16	110	95	500	18.0	21	105	90	200	32	28					
5500	115	100	1150	8	115	100	1200	4.5	12	115	100	900	9.0	15	110	95	550	16.0	20	105	90	250	29	26					

POWER PLANT SETTINGS: (DETAILS ON FIG. 26 SECTION III):

DATA AS OF 8-10-44 BASED ON: FLIGHT TESTS

FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH				HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
	POWER OFF		POWER ON		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET	
	MPH	KTS	MPH	KTS	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUNC ROLL	TO CLEAR 50' OBJ.
5500	100	87	100	87	700	1600	800	1700	900	1800	800	1700	900	1800	1000	1900	1800	2700	2000	2900	2200	3100
5000					700	1500	700	1600	800	1700	700	1600	800	1700	900	1800	1600	2500	1800	2600	2000	2800

DATA AS OF 8-10-44 BASED ON: FLIGHT TESTS

OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:

NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

LEGEND

I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

Figure 42—Take-off, Climb, and Landing Chart

AAFMC-528 8-1-44

AIRCRAFT MODEL(S)
AT-6
SNJ
ENGINE(S): R-1340-AN-1

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 5600 TO 4500 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING:

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (FIG. 26 SECT. III)
WAR EMERG.			SINGLE SPEED					
MILITARY POWER	2250	36	SINGLE SPEED	RICH	5 MIN.	260	65	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
350	300	111 100	450	390	520	450	590	510	111 100	670	580
310 280 240	270 240 210	90 80 70	410 360 320	350 310 270	470 410 360	400 360 310	530 470 410	460 410 360	90 80 70	600 530 470	520 460 400
210 170 140	180 150 120	60 50 40	270 230 180	230 200 180	310 260 210	270 220 180	350 290 230	300 250 200	60 50 40	400 330 270	350 290 230
100 70 30	90 60 30	30 20 10	130 90 40	120 80 40	150 100 50	130 90 40	170 120 60	150 100 50	30 20 10	200 130 60	170 110 60

MAXIMUM CONTINUOUS						PRESS	(4.55 STAT. (3.95 NAUT.) MI./GAL.)						(5.2 STAT. (4.5 NAUT.) MI./GAL.)						(5.9 STAT. (5.15 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
						40000 35000 30000																			40000 35000 30000						
2200	F.T.	RICH	41	190	165	25000 20000 15000							2000	F.T.	RICH	36	185	160	2000	F.T.	LEAN	32	185	160	25000 20000 15000	1700	F.T.	LEAN	25	165	145
2200	F.T.	RICH	48	200	175	10000	2050	F.T.	RICH	42	195	170	2000	F.T.	LEAN	37	190	165	1800	F.T.	LEAN	30	180	155	10000	1600	23	LEAN	23	155	135
2200	F.T.	RICH	58	205	180	5000	1950	30	RICH	42	190	165	2000	28	LEAN	36	185	160	1600	29	LEAN	29	170	145	5000	1600	24	LEAN	22	145	125
2200	F.T.	RICH	51	190	165	S.L.	1950	31	RICH	40	180	155	2000	30	LEAN	34	175	150	1600	30	LEAN	27	155	135	S.L.	1600	25	LEAN	20	130	115

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 42) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) THE MIXTURE CONTROL IN THIS AIRPLANE IS NOT AUTOMATIC AND MUST BE ADJUSTED MANUALLY TO OBTAIN SMOOTH ENGINE OPERATION AND BEST RANGE.

EXAMPLE

AT 5500 LB. GROSS WEIGHT WITH 76 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 35 GAL.) TO FLY 430 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2000 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: LEAN.

LEGEND

ALT. : PRESSURE ALTITUDE	F.R. : FULL RICH
M.P. : MANIFOLD PRESSURE	A.R. : AUTO-RICH
GPH : U.S. GAL. PER HOUR	A.L. : AUTO-LEAN
TAS : TRUE AIRSPEED	C.L. : CRUISING LEAN
KTS. : KNOTS	M.L. : MANUAL LEAN
S.L. : SEA LEVEL	F.T. : FULL THROTTLE

DATA AS OF 8-10-44 BASED ON: FLIGHT TESTS

PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 43 (Sheet 1 of 2 Sheets)—Flight Operation Instruction Chart

AAFMC-528 4-1-44

AIRCRAFT MODEL(S)
AT-6
SNJ
ENGINE(S): R-1340-AN-1

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 6000 TO 5000 POUNDS

EXTERNAL LOAD ITEMS
WING BOMBS
NUMBER OF ENGINES OPERATING: 1

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.			SINGLE SPEED				
MILITARY POWER	2250	36	SINGLE SPEED	RICH	5 MIN.	260	65

FOR DETAILS SEE POWER PLANT CHART (FIG. 26 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN **FUEL** COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT **RANGE** VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND **MIXTURE** SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
				SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]							
340	300	111 100	430	380	500	430	550	480	111 100	620	540
310 270 240	270 240 210	90 80 70	390 350 300	340 300 260	450 400 350	390 350 300	500 440 390	430 380 340	90 80 70	560 490 430	480 430 370
200 170 130	180 150 120	60 50 40	260 220 170	220 190 150	300 250 200	260 220 170	330 270 220	290 240 190	60 50 40	370 310 250	320 270 210
100 70 30	90 60 30	30 20 10	130 80 40	110 70 30	150 100 50	130 80 40	160 110 50	140 90 50	30 20 10	180 120 60	160 100 50

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(4.35 STAT. (3.8 NAUT.) MI./GAL.)						(5.05 STAT. (4.35 NAUT.) MI./GAL.)						(5.55 STAT. (4.8 NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE (2)	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
						40000 35000 30000																			40000 35000 30000						
2200	F.T.	RICH	41	185	160	25000 20000 15000							2000	F.T.	RICH	36	175	155	2000	F.T.	LEAN	32	175	155	25000 20000 15000	1750	F.T.	LEAN	25	155	135
2200	F.T.	RICH	48	195	170	10000	2050	F.T.	RICH	43	190	165	2000	F.T.	LEAN	37	185	160	1800	F.T.	LEAN	32	175	155	10000	1600	24	LEAN	24	150	130
2200	F.T.	RICH	58	200	175	5000	1900	30	RICH	43	185	160	2000	29	LEAN	36	180	155	1650	28	LEAN	30	165	145	5000	1600	25	LEAN	22	135	120
2200	32.5	RICH	51	185	160	S.L.	1950	31	RICH	41	175	150	1900	30	LEAN	34	170	145	1600	31	LEAN	28	155	135	S.L.	1600	26	LEAN	20	125	110

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 42) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) THE MIXTURE CONTROL IN THIS AIRPLANE IS NOT AUTOMATIC AND MUST BE ADJUSTED MANUALLY TO OBTAIN SMOOTH ENGINE OPERATION AND BEST RANGE.

EXAMPLE

AT **6000** LB. GROSS WEIGHT WITH 75 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 36 GAL.) TO FLY 450 STAT. AIRMILES AT **15,000** FT. ALTITUDE MAINTAIN 1750 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: **LEAN.**

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
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DATA AS OF *8-10-44* BASED ON: *FLIGHT TEST*

PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 43 (Sheet 2 of 2 Sheets)—Flight Operation Instruction Chart

AVIATION

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